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EDITED BY

COLONEL W. H. HORROCKS, K.H.S.

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Original Communications.

REPORT ON THE RESULTS OF THE BILHARZIA MISSION IN EGYPT, 1915.

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PART I: TRANSMISSION.

INTRODUCTORY.

THE lesions of bilharziosis are mainly due to the damage caused by the hard-shelled eggs of the parasite acting as foreign bodies in the tissues. Once the eggs are laid it is impossible to destroy them by treatment owing to the chitinous nature of the egg-shell. The effects continue with ever-increasing risk of complications and sequelæ for a number of years; until, in fact, the eggs succeed in escaping from the organ, bladder or bowel, in which they are deposited.

The only mode of dealing successfully with bilharziosis is to prevent its spread to uninfected persons.

The great economic loss resulting from widespread bilharzial infection was commented upon by Lord Kitchener in his annual report on Egypt for 1913, and the view is therein expressed that "it is high time that serious steps should be taken to prevent the continuity of infection that has been going on so long in this country."

The intractable character of the disease and the corresponding financial burden can be graphically illustrated from the experience of the Army. During the Boer War six hundred and twenty-five men were infected with bilharziosis in South Africa. In 1911, three hundred and fifty-nine of these were still on the list, exclusive of those meanwhile permanently pensioned. The cost to the State for "conditional" pensions for these three hundred and fifty-nine men was about £6,400 per annum. The "permanent pensions" already allotted amounted to an additional sum annually of £4,400 [128].

In the Nile Delta, bilharziosis is much more widespread and more severe in its manifestations than in South Africa. With the concentration of troops in Egypt it became desirable that the preventive measures taken against this disease should be made with a clear appreciation of the factors and the conditions under which

the disease is contracted and propagated. Unfortunately, although the parasitic nature of the disease had been established in 1851 nothing definite had yet been discovered of the life-cycle of the parasite or its manner of entering the human body. Early writers had supposed that the bilharzia worm, like other trematodes, required to undergo a metamorphosis in a molluscan intermediary before it became capable of infecting another person. In 1894, however, Looss formulated the hypothesis that the disease is communicable directly from man to man. In submission to his great authority in helminthological matters and his skill in dialectics, practically all research on the transmission of African bilharziosis undertaken during the last twenty years has been directed to the experimental verification of this hypothesis. During 1914 the author was in charge of the first Wandsworth Expedition of the London School of Tropical Medicine investigating the mode of spread of trematode infections of man in the Far East. Results which threw discredit upon the Looss hypothesis had just been acquired when the outbreak of war rendered field work impossible and necessitated an early return. The new facts were communicated to the War Office, and approval was given for the author to proceed to Egypt " to investigate bilharzia disease in that country and advise as to the preventive measures to be adopted in connection with the troops." Drs. R. P. Cockin and J. G. Thomson were associated with the author in the inquiry, and Private W. McDonald was transferred from the Sixth Essex (T.), as laboratory assistant.

The Committee of the London School of Tropical Medicine granted permission to all three members of their staff, while retaining their appointments, to accept temporary commissions for the period of the investigations. The requisite scientific apparatus was furnished by the School Committee. The Medical Research Committee (Insurance Act) allocated a special fund for all necessary field and other expenses incidental to the research. The Mission arrived in Egypt on February 8 and left again on July 15.

HISTORICAL.

Evidence of the occurrence of bilharzial disease in Egypt in ancient times has been found in early Egyptian records [388] and in the bodies of mummies now in the Cairo Museum [416]. In his Memoirs, Larrey [264] notes that symptoms of the disease were

frequent among the French troops during the Napoleonic Invasion of Egypt, 1799-1801. It was not until 1851, however, that the cause was recognized. In that year, Dr. Th. Bilharz, Assistant Professor at the Medical School in Cairo, wrote several letters to von Siebold announcing the discovery of a bi-sexual distome, which he named *Distoma hæmatobium*, and successfully establishing a definite relationship between this trematode worm and the symptoms of dysentery and hæmaturia resulting from the corresponding lesions of the intestine and bladder. These letters were published by von Siebold in the *Zeitschr. f. wissenschaft. Zool.* in the form of three articles during 1852 and 1853 [25], [26], [27].

DISCOVERY.

GEOGRAPHICAL DISTRIBUTION.

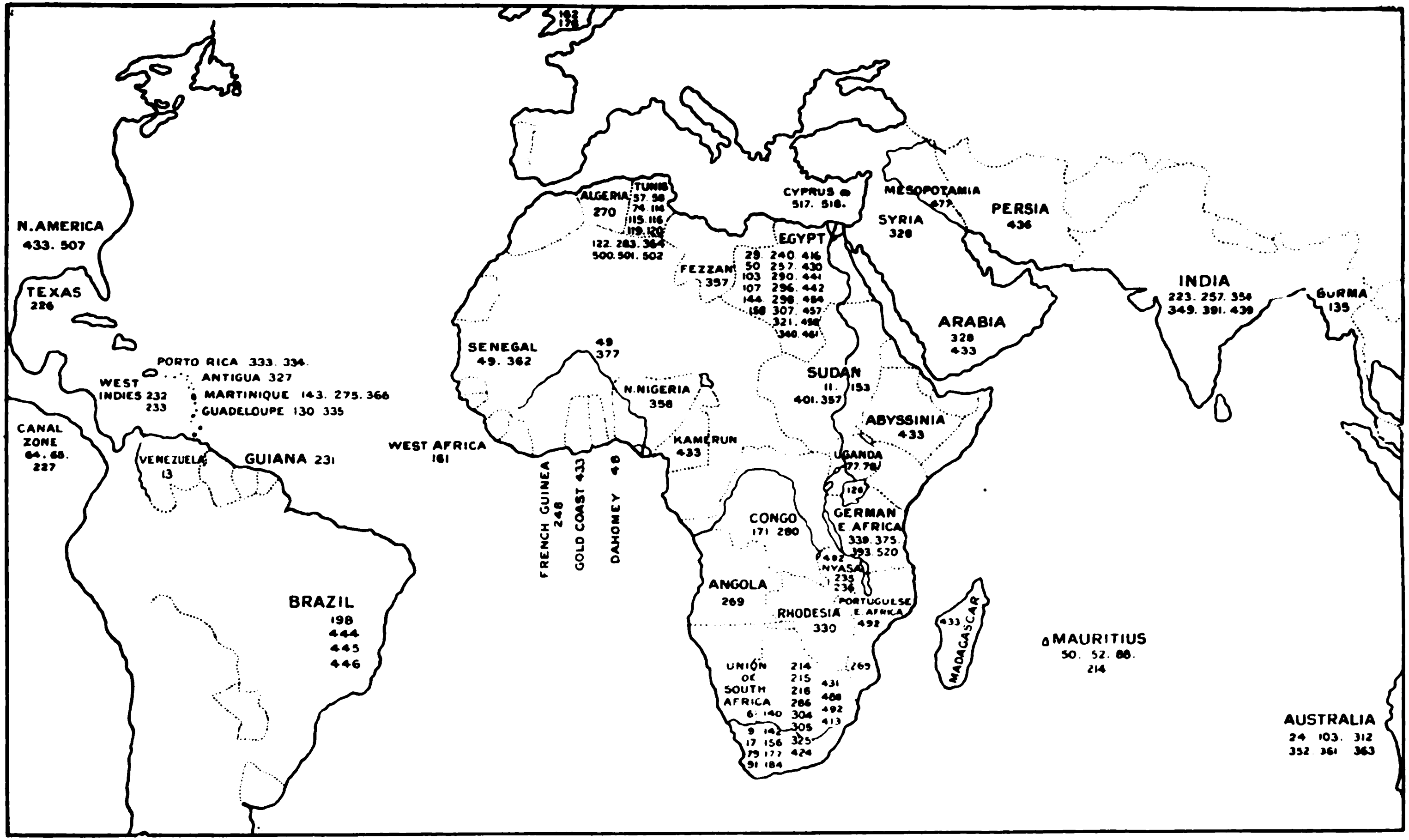
The disease occurs in most parts of Africa, in the outlying islands of Cyprus, Madagascar, Mauritius and Réunion; in Mesopotamia, West Indies, Porto Rico and Martinique especially, and in South America. Cases have occurred sporadically also in India, Australia, and England. The accompanying map gives the regions from which cases have actually been reported, with reference numbers to the papers in the Bibliography.

NOMENCLATURE.

In 1858 Weinland [515] created a special genus *Schistosoma*, for the *Distomum hæmatobium*. In the following year Cobbold [92] discovered a similar parasite in the mesenteric veins of the sooty mangaby, *Cercocebus fulginosus*. For this he used the new generic and specific terms, *Bilharzia magna*. Later, Cobbold accepted Leuckart's view that this species was identical with that described by Bilharz.

In 1864 Harley [214] showed that the endemic hæmaturia, common in certain parts of the Cape of Good Hope and Natal was due also to a species of Bilharzia, which he named *B. capensis*. Writing in 1871, Harley [216] confessed, "I have never had much doubt of the identity of the North and South African parasite, still, I can only deal with facts, and my position with regard to the question is pretty much the same as it was seven years ago. . . ." "Both Bilharz and Griesinger describe and figure *two* forms of egg, the one with a terminal and the other with a lateral spine. In all my own cases I can say positively that only one form of egg has existed, viz., that with a terminal spine. I have never seen any egg with even a tendency to the formation of a side spine." This differentiation of species was strongly opposed by Cobbold.

It would thus appear that the name *B. hæmatobia* was *primarily* associated by Bilharz with the parasites from the mesenteric veins



Distribution of Bilharzia Hæmatobia.
Key Map to Bibliography.

and those consequently concerned in the production of intestinal lesions, while the name *B. capensis* was proposed by Harley for that specially inducing vesical lesions.

In 1893 Manson [328] suggested, on grounds of dissimilar geographical distribution, that the vesical and intestinal forms of the disease were of separate origin. Adopting this suggestion, Sambon [425], in 1907, formally created a new species, *Schistosomum mansoni*, for the lateral-spined egg. Its validity was bitterly criticized by Looss [295], and the exact relation of this new name to the older specific names, *B. hæmatobia*, *B. capensis*, and *B. magna*, still remains to be finally established.

TERMINOLOGY. The disease has been variously named: (*a*) After the discoverer, bilharzia disease, bilharziosis, bilharziasis; (*b*) after the generic name of the parasite, schistosomiasis; (*c*) after the chief clinical manifestations, e.g., endemic hæmaturia, bilharzial dysentery, verminous cystitis, Cape hæmaturia, Egyptian hæmaturia; and (*d*) after the pathological situations, e.g., rectal bilharziosis, hepatic bilharziosis.

SEARCH FOR INTERMEDIARY. Bilharz does not appear to have made any observations upon the life-cycle or the probable mode of spread of the disease.

In 1854 Griesinger [200] conjectured that the young of Bilharzia "existed in the waters of the Nile, in the fishes which therein abound, or even in bread, grain, and fruit."

Harley [214], in 1864, wrote "according to the observations of Professor Siebold on the trematode worms, it may safely be assumed that between the ciliated embryo above described and the adult sexual animal there are probably two other distinct forms which serve to complete the chain of metamorphosis connecting these two extremes of development. What these forms are, and what their transmigrations, are questions which require careful elucidation. The ciliated embryo is adapted for an aquatic existence. Swimming freely about, these minute organisms probably come in contact with certain mollusca and become developed within them into what have been called cercaria sacs."

In his text-book on "Entozoa," published in 1864, Cobbold [95], after quoting Griesinger, remarks, "I think it is more probable that the larvæ, in the form of cercariæ, rediæ and sporocysts, will be found in certain Gastropod molluscs proper to the localities from whence the adult forms have been obtained."

The credit of having made the first attempts to trace the life-cycle through an invertebrate intermediary must be given to

Cobbold. His experiments, begun in 1870, were made in England with eggs obtained from persons who had returned from South Africa with hæmaturia. These experiments, which proved negative, are recorded in an article [101] "On the Development of *Bilharzia hæmatobia*," in 1872, in the following words:—

"I naturally sought for the possible intermediary bearers of Bilharzia among fresh-water molluscs and small crustacea. . . . I tried to induce the ciliated embryos to enter into the bodies of a great variety of animals such as gammari, dipterous larvæ, entomostraca, limnæi, paludinæ, different species of planorbis, and other fresh-water molluscs, but neither in them nor in sticklebacks, roach, gudgeon, or carp, did they seem inclined to take up their residence. These experiments, however, are by no means conclusive, since the conditions under which the experiments were made departed in several respects from those that are presumably essential to success in the ordinary course of Nature."

The first, and in many respects the most sustained effort to elucidate the problem in an endemic area was made by the Italian helminthologist Sonsino, principally during the last two years of his stay in Egypt from 1874 to 1885.

The report of his "Ricerche sullo sviluppo della Bilharzia Hæmatobia," issued in 1884 [462], shows that Sonsino's investigation followed upon rightly conceived lines. Having accepted Chatin's view that the presence of germinal cells in the ciliated embryo indicated preparations for a metamorphosis as in other trematodes, he attempted, in the endemic area:—

(*a*) To infect, experimentally, mollusca kept in an aquarium.

(*b*) To find larval Bilharzia naturally infecting some species of mollusc or insect.

The following species are definitely listed as giving negative results—(*a*) to experimental infection: **Vivipara unicolor, Cleopatra cyclostomoides, Cleopatra bulimoides, Physa Alexandrina,** and **Melania tuberculata,** and (*b*) to dissection: **Vivipara unicolor, Cleopatra cyclostomoides, Cleopatra bulimoides, Physa Alexandrina, Melania tuberculata, Physa micropleura, Physa Innesi, Limnæa natalensis, Planorbis schweinfurthi, Unio campanii, Unio Jickeli, Corbicula spp.,** and **Spatha caillaudi.**

The dissections revealed, however, a large number of trematode larvæ in the molluscs of Egypt. These developmental forms were described in a notable communication in 1892 [472].

From these investigations Sonsino concluded that "non é improbabile che la bilhariza che per tante particolaritá s'allontana

dagli altri generi di distomi offra ancora questa singolarità di avere per ospiti intermediarii animali di classi diverse da quelle che servono allo oviluppo degli altri distomi o quella di compire tutto il suo vilo vitalé in parte libero nell' acqua e in parte parasita in un solo ospite finale e forte senza reproduzione alternante."

In 1893-94, no fewer than three special missions visited North Africa to investigate Bilharzia transmission. Sonsino, then lecturer on parasites in the University of Pisa, proceeded to Tunis from Italy. The French Government sent Professors Lortet and Vialleton to Egypt. The University of Leipzig provided funds for Dr. Looss, Assistant to Professor Leuckart, to proceed to Alexandria.

Sonsino [469] reported that, after many experiments with different kinds of fresh-water molluscs (including **Melania tuberculata, Melanopsis præmorsa** and ? **Amnicola similis**) and arthropods, he had succeeded in obtaining evidence that a small crustacean was an infected intermediary host of Bilharzia; that the Bilharzia had a life-history differing from the typical one of the digenetic trematodes, as represented by *Fasciola hepatica;* that it required an intermediary host and underwent a metamorphosis, without asexual (or alternation of) generation, "thus resembling the holostomes"; that the free embryo having effected an entrance proceeded to encyst itself and that the encysted larva, being transferred with the crustacean in drinking water to the human stomach, was then set at liberty. After penetrating the intestinal walls, it arrived in the portal vein, where, presumably, it completed its development.

Further work led Sonsino [471], in the following year, entirely to withdraw these conclusions as untenable. In the same article he records without comment the discovery of larvæ in **Melania tuberculata** which he refers to **Cercaria ocellata** and which, as will be shown later in this report, is closely allied to Bilharzia.

Lortet and Vialleton [303] failed to transmit the disease directly to animals by feeding and inoculation, or to obtain infection of plants, aquatic arthrcpods, or molluscs; the following species of mollusca being specifically mentioned: **Unio ægyptiacus, Corbicula consobrina, Physa acuta, Vivipara unicolor, Lanistes carinatus, Lanistes boltenianus,** and **Melania tuberculata.**

Further experimental work was done by Lortet at Lyons in France, with several local species of Limnæa, but without success.

Later, in 1905, Lortet [302] published these "Expériences nouvelles sur le developpement et la mode de pénétration du Bilharzia

hæmatobium": "Dans un aquarium nous avons versé tous les jours des embryons et des œufs de *Bilharzia* qui étaient ainsi mis en contact avec diverses espèces de mollusques aquatiques appartenant aus genres Limnæa et Planorbis.

"Dans quelques-uns de ces mollusques, nous avions rencontré des kystes que nous pensions être différents de ceux de la douve commune. Des milliers de ces mollusques que nous supposions devoir être infectés on été ingéré, mêlès à du son, par un veau, des moutons, ainsi qui par un singe. Les resultats ont été également négatifs."

Dr. Looss' report of his investigation is contained in a critical article [288] upon a paper of Dr. G. S. Brock [67]. His conclusions are copied here in extenso:—

"Als das Wahrscheinlichste und zunächst zu Erwartende war es natürlich anzusehen, dass der aus der Eischale befreite Embryo nach Art der übrigen Distomenembryonen in einen Zwischenwirt aus der Klasse der Weichtiere eindringe. Ich wiederholte bei den Experimenten in dieser Richtung die Versuche Cobbold's und Sonsino's, aber mit dem gleichen, durchaus negativen Erfolge. Weder bei den haüfigsten Gasteropoden des Nildeltas (**Cleopatra bulimoides, Melania tuberculata, Vivipara unicolor, Lanistes carinatus, Physa Alexandrina**) noch bef Lamellibranchiaten (**Corbicula Caillaudi**) zeigte sich irgend eine Infektion, gleichviel, ob dieselbe bei Tage, im direkten Sonnenlichte, oder bei Nacht, ob sie bei erhöhter oder gewöhnlicher Temperatur, in grossen oder kleinen Bassins versucht wurde. Gleich negativ waren die Bemühungen, in denselben Mollusken, die auf oft mehrtägigen Exkursionen an notorischen Infektionsherden des Deltas gesammelt waren, irgend eine Cercarienform aufzufinden, welche auch nur mit einiger Wahrscheinlichkeit auf die Bilharzia hätte bezogen werden können. Namentlich diese letzteren negativen Erfahrungen sind es, welche mich veranlassen, die Mollusken jetzt definitiv als Zwischenwirte für unseren Wurm ausser Rechnung zu stezen. Derselbe ist in Aegypten so häufig, viel häufiger, als es die bisher veröffentlichten Statistiken die allerdings Stadt und Landbevölkerung gleichmässig betreffen, während ich mich bei meinen Untersuchungen hauptsächlich an die letztere hielt—nachweisen, dass man, falls eine Cercarie der Bilharzia im Freien existierte, sie daselbst sicher und auch häufig finden müsste. Und das um so mehr, als die Mollusken der Nilwässer ungemein häufig Cercarien beherbergen: 50-60 Proz. zeigen sich fast überall infiziert, an manchen Orten aber erwiesen sich von 100 untersuchten nur 2 frei von Parasiten!

"Dasselbe Resultat ergaben in ganz der gleichen Weise angestellte

Versuche mit Crustaceen und Insektenlarven (Daphnia, Cyclops, Chironomus, Culex, Ceratopogon, Ephemera, u.a.).

"Nicht glücklicher verliefen, nachdem so auch Crustaceen und Insektenlarven als mutmassliche Zwischenträger des Wurmes hatten von der Liste gestrichen werden müssen, entsprechende Versuche mit kleinen Würmern und Fischen."

"Das eben betonte Verhalten der Embryonen anderen Tieren gegenüber war es nun auch wesentlich, welches mich schliesslich zu der definitiven Ueberzeugung brachte dass die Uebertragung der Embryonen mit Hilfe eines Zwischenträgers aus der Klasse der niederen Tiere nicht vor sich gehen könne. Es blieb deshalb nur noch die Möglichkeit übrig, dass der Embryo direkt in den Menschen gelange und dort zu einer Sporosyste auswachse, die ihre Brut dann an ihren Träger abgebe."

Naturally, the most likely course and that which one expected *a priori* was for the embryo after escaping from the egg-case to penetrate, in a manner similar to that observed in other species of distoma, into some intermediate host appertaining to the class of mollusca. In my experiments in this connexion I repeated those of Cobbold and Sonsino, but with the like absolutely negative results. Neither in the most frequently occurring gastropods in the Nile Delta (*Cleopatra bulimoides*, *Melania tuberculata*, *Vivipara unicolor*, *Lanistes carinatus*, *Physa Alexandrina*) nor in the lamellibranchiates (*Corbicula Caillaudi*) was any sign of infection to be detected, whether the experiment was carried out in the day-time, in direct sunlight, or at night, whether at high temperatures or normal ones, whether in large or in small troughs. Equally negative were the results of attempts to find cercaria forms, which could with any probability be referred to *Bilharzia*, in samples of the same mollusca collected on excursions, sometimes extending over several days, from notorious foci of infection in the Delta. It is more particularly these latter negative experiences that induce me now definitely to exclude mollusca as the intermediate hosts of our parasite. The latter is of such frequent occurrence in Egypt, far more so than would appear from the published statistics---though I admit that these refer to both urban and rural populations, whereas my experiments refer mainly to the latter—that the cercaria form of the Bilharzia, if such exists in a free state, ought to be met with frequently and with certainty under such conditions. And this should be so all the more, considering that the mollusca found in the waters of the Nile harbour cercariæ with remarkable frequency; nearly everywhere from fifty to sixty per cent. are found to be infected, and in some localities only two out of every hundred proved to be free from parasites.

Experiments conducted in a similar manner with crustacea and insect larvæ (daphnia, cyclops, chironomus, culex, ceratopogon, and others) yielded the same result.

Crustacea and insect larvæ having had to be struck off the list of likely hosts of Bilharzia, analogous experiments were carried out with small worms and fish; the results were just as unsatisfactory.

The above described behaviour of the embryos towards other animals was in the main what led me finally to the definite conviction that probably no transference of the embryos by means of an intermediate host appertaining to the classes of the lower animals takes place. Hence the only possible solution that remained was that the embryo reaches man directly, and develops into a sporocyst in the human host, the offspring of the cyst being subsequently distributed to its host.

In 1896 Looss published, in "Recherches sur la Faune parasitaire de l'Egypte" [290], a detailed account of the larval forms

met with in the course of his dissections. With five exceptions these had already been described, in less detail, by Sonsino in 1895. It is noteworthy that seven of the forms described by Sonsino do not appear to have been found by Looss. The molluscs from which the larval forms were obtained belonged to the following species: **Vivipara unicolor, Cleopatra cyclostomoides, Cleopatra bulimoides, Physa alexandrina, Physa micropleura, Melania tuberculata, Limnæa natalensis,** and **Corbicula Caillaudi,** all of which had already been examined by Sonsino. A short time after the issue of this paper, Dr. Looss received an appointment on the staff of the School of Medicine in Cairo. His next contribution to the Bilharzia question was published in 1905, as a paper [294] on the "Histoire Naturelle de la bilharzia," read before the "Premier Congrès égyptien de médicine":—

"Des expériences . . . faites par Cobbold, en Angleterre, par Lortet, en France, et par moi, en Egypte, eurent, sans exception, le même résultat négatif. J'avais simultanément examiné des centaines d'exemplaires des différentes espèces de mollusques égyptiens recueillis dans des endroits où la bilharziose m'avait été rapportée comme étant très commune. S'il y avait une cercaire de la bilharzia correspondant à celle des autres distomes, j'aurais dû la trouver, mais je ne découvris rien de semblable. J'ai finalement observé au microscope la conduite des embryons de la bilharzia en présence des mollusques sus-mentionnés ou de fragments de leurs corps : or tandis que les embryons d'autres distomes qui se développent en réalité dans des mollusques, sont attirés même par des débris encore vivants du corps de ceux-ci et s'efforcent d'y pénétrer, les embryons de la bilharzia, eux, ne prêtaient pas la moindre attention aux mollusque que je leur avais présentés."

"Toutes les observations mentionnées et d'autres encore, tendaient donc à établir que les mollusques ne peuvent pas jouer un rôle dans le développement de la bilharzia."

In a polemical article, "What is *Schistosomum mansoni?*" in the *Annals of Tropical Medicine and Parasitology* for 1908, Looss [295] again asserts :—

"All attempts made by former authors to discover an intermediary host in which this development is gone through have failed, and so have my own efforts. I have examined hundreds of specimens of all the molluscs common in the Nile Valley without finding any sporocyst which might have been brought into relation with the Bilharzia worms. I have placed quantities of

free-swimming miracidia in contact with the same molluscs without obtaining an infection. It is easy to infect molluscs with miracidia of species which actually develop in them. Bilharzia miracidia were never seen to take any notice of any mollusc in their neighbourhood, whereas others developing in a certain mollusc soon begin to swarm about it, and may, under the microscope, even be observed to enter into it. The same negative results were observed with larvæ of insects, with fishes, and with plants. I am thus forced to the conviction that man himself acts as an intermediary host."

"In man, the miracidium must develop into a sporocyst which either directly or indirectly generates the Bilharzia worms. The only organ of the body thus far known to harbour young, and sometimes very young worms, is the liver. I therefore conclude that the liver is the habitat of the sporocyst from which the worms later escape into the portal vein."

In 1909, in a controversial paper entitled "Bilharziosis of Women and Girls in Egypt in the Light of the Skin Infection Theory," Dr. Looss [296] replies dogmatically to some brief comments on the insufficiency of his hypothesis made by Drs. Elgood and Sandwith at the Annual Meeting of the British Medical Association:—

"Any theory about the mode of infection with bilharziosis, in order to be at all acceptable, must (*a*) account for the passages of the miracidium both from man to water and from water back to man; it must (*b*) duly consider both the habits of the host and the biological peculiarities of the parasite.

"The theory of miracidium infection by the skin is in accordance with all the facts thus far known (*a*) of the biology of the parasite, (*b*) of the distribution of the disease among the population (native and foreign, town and rural) of Egypt. It shows (*c*) how the chief sufferers—the children in town, the adult males in the country—live under conditions which, from the epidemiological point of view, are essentially the same, and give the miracidia (*d*) the opportunity of passing, within the short time of their life, from man to water and from water back to man."

In a popular lecture [297] on the "Life-history of the Bilharzia Worm," before the Cairo Scientific Society in 1910, Dr. Looss again declared:—

"What we know of this, the life-history of the parasite, is the following:—

"The worms which infect a fresh subject originate from the

eggs which have left the preceding host with the urine or the fæces. The only medium in which they find the condition for further development outside man is water." "Authors have tried to find a mollusc capable of rearing the germs of Bilharzia; I have personally experimented with all the species occurring in the Nile Valley, but in vain. I equally failed with larvæ of insects living in water, with various species of fish, with plants, etc. In such circumstances the only alternative left was to assume that the germs from the water immediately return into man, making their way to the liver, where they reproduce the *Bilharzia* worms."

During 1911-13 Japanese investigators had succeeded in infecting cattle, cats, and dogs with an allied disease, caused by *Schistosoma japonicum*, by immersing the animals in the flooded fields of infected areas, but had quite failed to obtain infection by similar immersion in water containing large numbers of live miracidia. Commenting upon this in 1914, Dr. Looss [300] says:—

"Merkwürdig ist dass die japanischen Autoren anscheinend zu keiner Klarheit über die Natur der Invasionsform kommen können." "Nach [Miyawa] zeigt die Invasionsform einen so beträchtlichen Unterschied" von dem Mirazidium, dass die Existenz eines Zwischenwirtes wahrscheinlich wird. Ist dies richtig, dann müsste sich *B. japonica* in ihrer Entwicklung wesentlich von *B. hæmatobia* unterscheiden, denn wie ein im Wasser lebender Zwischenwirt an der Verbeitung der letzteren in den Städten Ægyptens beteiligt sein soll, scheint zunächst schwer verständlich."

It is remarkable that the Japanese authors do not appear to be able to come to any clear concept as to the nature of the invading form. According to Miyawa, the invading form manifests such marked divergences from the miracidium, that the existence of an intermediate host seems probable. If this statement is correct,[1] *Bilharzia japonica* must differ essentially in its development from *B. hæmatobia*, for it seems *a priori* difficult to understand how an intermediate host that lives in water can participate in the spread of *B. hæmatobia* in the towns in Egypt.

Direct Infection Experiments. The earliest attempts to obtain direct infection experimentally were made by Harley [216] in 1871. "Two young rabbits and two dogs were allowed to take, at intervals with their food, pellets of the mucus containing swarms of the eggs. Three of these animals were killed after an interval of two, three, and six months respectively, and carefully examined, but no trace of Bilharzia could be found."

Mantey is reported to have made some experiments in 1880, but his account [331] has not been accessible. The results are quoted by Looss as having been negative. Lortet and Vialleton

[1] This has been experimentally demonstrated by Miyairi and by Leiper and Atkinson.

attempted to infect guinea-pigs by passing the Bilharzia eggs into the stomach through a tube. They also injected the eggs into the saphenous vein of rabbits, and also attempted to infect a Macacus monkey by mixing large numbers of eggs in its food. These experiments were uniformly unsuccessful.

Having convinced himself that the Bilharzia did not require an intermediate host, Looss [288] attempted, in 1894, to infect monkeys by the mouth.

"Die Versuche wurden jetzt so angestellt, dass die ausgeschlüpften Embryonen mit filtriertem Wasser ausgewaschen und dann in reines, ebenfalls filtriertes Wasser übertragen und mit diesem an verschiedene Tiere zum Trinken gegeben wurden. Mit dem Menschen selbst zu experimentieren, ging leider nicht gut an; es würde, glaube ich, in Aegypten auch kein einwandsfreies Resultat ergeben haben, denn fast jeder zweite oder dritte Mann ist dort bereits von selbst infiziert. Ich benutzte deshalb Affen verschiedener Species, bei denen ja durch Cobbold ebenfalls das Vorhandensein einer Bilharz konstatiert wurde. Die Tiere bekamen durch 6 und 8 Wochen hindurch täglich ein, zwei, teilweise sogar drei Mal von dem stark embryonenhaltigen Wasser zu trinken, dasselbe wurde teils in gewöhnlicher Temperatur, teils auf 37° C. erwärmt gegeben einer Temperatur, bei der sich die Embryonen ausserordentlich lebhaft und agil zeigen—die spätere Untersuchung (nach 8 und 10 Wochen) mehrerer Affen ergab aber in allen Fällen ein durchaus negatives Resultat!"

The experiments were now carried out as follows: the freed embryos were washed in filtered water and then transferred to clean, likewise filtered, water, and this was given to various animals to drink. It was unfortunately impossible to experiment with the human being; and, indeed, in my opinion no incontrovertible results would have been obtainable in Egypt by such a method, considering that practically every second to third person is already infected. I therefore employ monkeys of various species, Cobbold having shown that a Bilharzia is found to occur in them. During from six to eight weeks the animals were given some of this highly embryo-infected water to drink once, twice, and in some cases even three times a day; the water was given either at the ordinary temperature or at 37° C., the latter temperature being one at which the embryos are found to be extremely lively and agile; subsequent examination of several of the monkeys (after from eight to ten weeks) yielded in every case absolutely negative results.

SKIN INFECTION THEORIES.

The hypothesis that an unknown larval stage might enter the body through the skin had already been formulated in the *Practitioner* for 1888, by Allan [6], who wrote, "Nearly all the youths bathing in the Umzimdusi and Dorp Spruit are infected, while the girls, who do not bathe, remain free of the disease." In 1894 Brock [67] strongly supported this view: "My own inquiries have led me to the conclusion that

bathing is, in this neighbourhood, at any rate, the most fruitful source of the infection. I cannot, among several hundred instances, recall one exception to the rule that all who suffer from the parasite have been in the habit of bathing. Moreover, it is among boys, who are fondest of swimming, that the symptoms earliest make their appearance; and I believe it would be hard, if not impossible, to find one boy much given to bathing in the streams, or their tributaries, who does not, before reaching manhood, become a subject of the disease. Only on this theory is explicable the fact noted by various observers in South Africa that the female sex is rarely attacked by *Bilharzia*.

"That the drinking of impure water is a common factor in the process of infection there is no lack of evidence; indeed, it would be unreasonable to think otherwise if the bathing hypothesis be well grounded. But, other things being equal, the chances of infection occurring will be greater from the large quantity of water which must come in contact with the body in bathing, than from the comparatively small amount conveyed into the stomach by drinking; so that, granting the larvæ to have the power of penetrating the body by some means, we should expect to meet with a much larger proportion of cases among bathers than among those who only drink the infective water.

"There is no evidence whatever that infection can take place by direct contagion. The question of how infection occurs will, however, only be satisfactorily solved when we have succeeded in tracing the development of the parasite through all its stages."

It was in an article (1894) criticizing this paper that Looss, while adopting the view taken therein that infection occurs through the skin, first maintained, on biological grounds, that the infective agent was the miracidium [288].

The biological facts upon which he based this deduction were explained by Looss [294] to the Egyptian Medical Congress in 1905, "il me sembla important de savoir si les embryons pouvaient, oui ou non, résister à l'influence des acides de l'estomac. J'ajoutai sur un porte-objet, au bord d'une goutte d'eau contenant quelques embryons vivants, un petit morceau de la muqueuse stomacale d'un singe récemment sacrifié et le comprimai légèrement pour en faire sortir quelque peu de suc. Dès que les embryons arrivaient à proximité de cette partie de la goutte, leurs mouvements cessaient presque instantanément. J'ai, plus tard, répété ces experiences avec un acide dont je connaissais la concentration. Une douzaine de larves, à peu près, ayant été recueillies dans un petit verre de

montre rempli d'eau pure dans laquelle ils nageaient aisément, une goutte d'une solution aqueuse d'acide hydrochlorique à un pour mille fut ajoutée avec précaution sur un côté du verre, mais sans mouvoir ce dernier. Aussitôt que les embryons, tout en nageant, entraient dans la zone acidulée, les mouvements de leur revêtement vibratile cessaient presque aussi vite que dans l'expérience avec le suc stomacal du singe. Les corps avaient encore quelques mouvements de contraction, mais au bout d'environ deux minutes les embryons étaient complètement morts. Peu à peu, huit embryons entrèrent de cette manière dans la zone acidulée et chez tous l'action de l'acide se montra absolument la même. L'expérience fut alors répétée, mais avec une solution d'acide à un pour deux mille. Même résultat que dans l'expérience précédente, avec cette simple différence qu'ici la mort définitive des embryons était un peu retardée.

" D'après ces expériences, il me semble impossible que les embryons libres, avalés avec la boisson, puissent franchir vivants l'estomac de l'homme. Vu ce résultat, il ne reste donc plus qu'une possibilité pour les embryons de pénétrer dans le corps humain ; de percer leur voie activement à travers la peau. Il y a quelques années que j'ai été conduit à cette conviction à la suite d'observations spéciales, et je peux dire que les observations occasionnelles que j'ai faites entre temps, ne m'ont que confirmé dans mon opinion."

"Malheureusement, je ne peux pas encore vous fournir la preuve incontestable par l'expérience. J'ai déjà entrepris quelques tentatives pour faire entrer les larves dans des animaux, mais ces expériences, peu nombreuses du reste, et exécutées sans système, n'ont pas donné des résultats décisifs."

The next attempt was made in German East Africa by Wolff, who failed to infect a cat by immersion for half an hour in water swarming with miracidia. His experiment is briefly recorded in *Archiv. f. Schiffs- und Tropenhygiene* for 1911 [521].

In 1912 F. E. Bour [51] wrote from Mauritius to the *Journal of Tropical Medicine and Hygiene* :—

" Four months ago an attempt was made to infect two monkeys (*Macacus cynomolgus*), one by keeping for one and a half hours in the hollow of his abdomen, closely shaved, some water containing numerous miracidia ; the other by dropping the same water into his mouth and on the mucosa of his lips and cheeks. Up to the present time no Bilharzia eggs have been detected in their urine."

In 1914 Conor [122] carried out an extensive series of experiments in Tunis to obtain direct infection. Miracidia were adminis-

tered to various species of monkey, to sheep, rabbits, guinea-pigs, and rats. Subcutaneous injection, applications to the shaven skin, attempts to infect by bathing and by the mouth, were without result in every case.

A number of experiments have also been made by Fülleborn, by certain of Dr. Looss's colleagues and by the author, but lacking success, these have not been put on record.

These repeated failures to obtain experimental verification of his theory are explained away by Looss [300] with the statement that man is the only known host of *Bilharzia hæmatobia*.

DISSENTIENTS. It is right to add that a number of authorities, notably Blanchard and Manson, have consistently withheld their assent to the Looss hypothesis. In "Maladies parasitaires" Blanchard [37] wrote in December, 1895:—

"Il est hors de doute que l'embryon éclôt normalement dans l'eau et qu'il pénètre dans le corps d'un animal aquatique, pour y accomplir sa phase larvaire. Neanmoins on n'a pu jusqu'ici découvrir en quoi consistaient ses métamorphoses et chez quel hôte elles s'accomplissaient. Lortet et Vailleton . . . ont cherché l'embryon et la Cercaire dans les eaux des rivières et des mares d'Égypte au moyen de pêches au filet fin, sans pouvoir le rencontrer jamais. Ils ont dressé la liste des animaux qui vivent dans ces eaux et les ont examinés avec le plus grand soin, sans jamais y trouver aucun parasite qui soit imputable à l'une des phases de l'évolution de la Bilharzie. Le mode de développement et de propagation de ce Trématode reste donc encore entouré d'un profund mystère."

In 1905 Sir Patrick Manson [329], in his "Lane Lectures on Tropical Diseases" (p. 50), expressed the opinion that Bilharzia is "another illustration of the conveyance of a disease germ through water and probably by a fresh-water intermediary," while in the latest (1914) edition of his text-book on "Tropical Diseases" he writes: "Analogy suggests that the miracidium passes into the body of some fresh-water mollusc, crustacean, or larval arthropod, there to undergo the developmental changes in the redia and possibly the cercaria stages usually exhibited by the trematodes. Later, it may become encysted, and then, either free or still in the body of the intermediate host, gain access to man by penetrating the skin or through the stomach, and so pass to the veins of the portal system."

"Looss has expressed the opinion that, unlike other trematodes,

Schistosomum hæmatobium does not require the services of an intermediary host, and that the miracidium enters the human body directly by penetrating the skin." "I would remark that if *S. hæmatobium* does not require the services of an intermediary host its peculiar geographical limitations are difficult to explain."

In the following year Balfour [12] tentatively subscribed to the hypothesis that a minute crustacean was the essential carrier. He says: "In the first report the prevalence of the disease amongst the boys attending a primary school in Khartoum was mentioned. Many of these boys drank from the school well, and this water was submitted to examination. A tiny but very active entomostracean, probably belonging to the order *Ostracoda*, just visible to the naked eye, was seen.

"Six active embryos were placed in water along with three of the lively crustaceans and left over night. In the morning one dead embryo was found lying on the foot of the watch-glass, the other five had wholly disappeared, and the crustaceans remained alive and active. What had become of the missing five? Presumably they had entered or been taken up by the crustaceans."

Two years later (1908), in their "Review of Recent Advances in Tropical Medicine" [14], Balfour and Archibald add: "Time has not permitted further experiments with the species of Ostracode mentioned in the Second Report, but certainly the results obtained were suggestive."

LOOSS'S INDICATIONS FOR PROPHYLAXIS.

The practical requirements of his theory of direct infection are indicated in the following abstracts from his publications during 1908-14:—

(1908.) *Ann. Trop. Med.* [295]: "If this conclusion [infection by miracidia] is correct, it leads to the important consequence that the spread of the *S. hæmatobium* is not limited by the natural geographical distribution of a special intermediary host. It can spread wherever man carries it, so long as, and in so far as, the climatic and hygrographic conditions are favourable for its development." "The Egyptian peasants usually work their fields in companies; sometimes of two or three, sometimes of several dozens, standing with their feet, and working with their hands, in the water or the mud. They often also bathe in companies in canals with slowly flowing water, pools, etc. One of them who is infected with urinary bilharziosis, when urinating into the water, infects it with several hundreds, perhaps thousands, of eggs. In warm weather the miracidia hatch within a few minutes. They have at once the opportunity of finding a new shelter, either in the skin of the man

who voided the eggs or in the legs and hands of one of his comrades working close by him. . . . These possibilities of infection are repeated every time a man urinates into the water. They are perhaps repeated every day the season of the Nile flood lasts."

(1909.) *Brit. Med. Journ.* [296]: "When once free from their eggs' shells they [the miracidia] disperse in the water to all sides, and the chance of reaching a suitable shelter considerably decreases for the individual miracidium with time and distance. The more I think of this latter circumstance the more I become convinced that the chief foci of infection—that is, the places where strong and repeated infections are contracted—cannot be found in large bodies of waters, as rivers, canals, ponds, etc., but must be sought in small accumulations of water, in which the miracidia, once introduced, cannot become widely dispersed."

"To render an infection of the skin at all possible . . . the following conditions must be realized: An infected person must urinate (or defæcate) in a place where there is water, however small the quantity. The place must remain moist for some time, but not longer than thirty to forty hours. Within this period another person must bring some part of his skin for some time into actual contact with the moisture. If these conditions are fulfilled the miracidia have the *possibility* of getting from man to water and from water back to man; their life-cycle may be closed.

"The infective power of moist places *gradually decreases* and is *again nil* at the end of one or two days even if they remain moist. A recent contamination must take place in order to render them infective again for a short period."

"The moist places demanded for infection are to be found plentiful about town: in the streets there remain puddles for several days after each rain or for several hours after each watering; the courtyards of the houses also are often watered especially in the warm season. In many Arabic houses water-closets are an unknown institution or they are of the most primitive type. The calls of Nature are often obeyed in the streets, oftener in the courtyards, especially for urinating. There is thus sufficient occasion for the ground to become over and over again populated with live miracidia: their short life is of no consequence. There only remains the host to supply the miracidia and another to take them up again."

"Contaminated water loses its infective power again after having been protected from fresh contamination for one or two days."

(1910.) [297] "Taking the [miracidium] infection by the way of

the skin as an established fact, the measures to adopt for preventing it are clearly given. First of all, infected persons should never evacuate urine or fæces into water, for this is the only way in which the latter becomes populated with the dangerous germs. If any body of water can be shown to be safe from contamination, it must, as a matter of course, be left out of consideration as a source of infection. If water is likely to be, or is likely to have been, contaminated, it should not be used for bathing, washing, or working in before about two days have passed. But even here a certain reasonable discrimination should be made. For in a large body of (standing or flowing) water, e.g., the Nile, any germs are soon so much dispersed that the possibility of picking up one or another becomes very small and may be increased only by a very prolonged contact with the water. Dangerous in the first place are small bodies of standing water, both permanent and transitory, because in these the germs cannot disperse."

In the last edition of Mense's "Handbuch der Tropenkrankheiten" (1914) he claims:—

"Besteht die Haut infektion im Wirklichkeit (sie wird neuerdings von immer zahlreicheren Autoren als wahrscheinlichen bezeichnet) so ist zu beachten, dass eine Auto-Reinfektion auch bei Wannenbädern mögleich erscheint, wenn der Badende unter sonst gunstigen Bedingungen (absichtlich oder unabsichtlich) Eier in des Wasser entleer."

If cutaneous infection really occurs—latterly an ever increasing number of authors mention such an infection as probable—it is worthy of note that auto-reinfection appears to be possible also when taking baths indoors, supposing the bather, other conditions being favourable (either intentionally or unintentionally), voids the ova into the water.

Blanchard's views on prophylaxis are expressed in the following passage from his "Traité de Zoologie Médicale" [34], 1899:—

"L'infestation se fait par les eaux de boisson, soit qu'on ingére l'hôte intermediaire lui-meme, et alors il s'agirait d'un mollusque de petites dimensions, soit plutôt qu'on avale la Cercaire nageant librement dans l'eau. . . ."

"On a supposé que le parasite pénétrait dans l'organisme à travers le peau et, par suite, on a interdit formallement les bains de rivière cette interdiction ne nous semble aucunement justifiée; encore que nous ignorions les phases ultimes du développement, il y a disérieuses raisons d'admettre que l'Helminthe pénètre réellement par la voie que nous avons indiquée plus haut. C'est donc l'usage d'eau non filtrée ou non bouillie qu'il faut rigoureuse-

ment proscrire dans les pays contaminés ; l'usage des bains est indifférent."

In 1908 in a brief note, "Le renvoir d'un Collegien atteint de Bilharziose est-il legitime?" in the *Archives de Parasitologie*, he wrote:—

. . . "il serait donc très utile de savoir où le jeune homme habite ordinairement. . . . quelle eau il boit ordinairement: eau d'une source vive, d'un puits ou d'une citerne? Y-a-til dans cette eau des mollusques ou coquillages et peut où on obtenir des spécimens? De dernier point est de le plus haute importance.

La bilharziose n'est pas une maladie contagieuse. Il n'y a donc *aucune raison* pour refuser de garder au lycée un jeune homme qui en est atteint: il n'est aucunement dangereux pour ses camarades."

Manson's opinion on prevention, as given in his "Tropical Diseases" [328] in 1905, is as follows:—

"Since analogy justifies the belief that the embryo of Bilharzia on obtaining access to fresh water enters a fresh-water animal and by it obtains access to another human host, it is evident that if the embryo be kept from getting into the water or if drinking water be boiled or filtered, the spread of the disease from man to man would be effectually prevented. In the endemic districts children in particular should be carefully and repeatedly warned against drinking the water of ponds and canals. Provided reinfection be avoided by the exercise of prudence in the matter of drinking* water, there is no necessity for sending the patients with Bilharzia disease away from the country in which the parasite was acquired."[1]

In a popular lecture to the Rhodesia Scientific Association [330] in January, 1914, Sir Patrick Manson said, after briefly outlining the development of the liver-fluke : "In a similar way I believe the germ of Bilharzia disease, so common in this country, especially in young people and probably contracted in bathing in pools and rivers, is acquired and spread."

INCIDENCE OF BILHARZIOSIS IN EGYPT.

The published statistics of the incidence of Bilharziosis in Egypt have been based mainly upon hospitals records. Reliable statistics are notoriously difficult to obtain in Egypt, owing to the ignorance

[1] In the fifth edition (1914) the above paragraph is slightly changed by the addition of the words "or bathing in" after "repeatedly warned against drinking" and by the deletion of the word "drinking" marked by an asterisk *.

and suspicion of the mass of the people and their deep-rooted objection to having their names or affairs set down in any paper or book that may form part of the Government archives. Such an ordinary chronic condition as Bilharziosis is frequently not thought worthy of mention in addition to any other disease the patient may wish treated or which may be the cause of death. There are certain beliefs, too, apparently considerably prevalent, which not infrequently account for concealment. Many cases, therefore, go entirely untreated and unrecognized.

Griesinger [201] found 32 per cent of infections in 363 autopsies made in Cairo up to 1856. Sonsino [453] obtained 46 per cent from 91 autopsies. In 1894 Kauffman [321] recorded from 500 autopsies that 369 males gave 40 per cent and 131 females gave 11½ per cent, i.e., a general average of 33·3 per cent with Bilharzia. Ferguson [168], in 1910, stated that his observations, based on considerably more than 1,000 post-mortem examinations at the Kasr Aini Hospital in Cairo, revealed the presence of this disease in no less than 40 per cent of Egyptian male subjects between 5 and 60 years of age. In 1905 Milton [346] showed that 930 patients were treated for Bilharzia as in- or out-patients at Kasr Aini Hospital during 1901.

In 1910 Professor Madden [321] published the figures from the annual reports of the Kasr Aini Hospital for the three years 1907-09, showing a total number of admissions for medical and surgical diseases 11,698, of which 1,270, i.e., about 10 per cent, had Bilharziosis. These cases represent only persons "suffering from pathological destruction of kidneys, ureters, bladder, urethra, and rectum, produced by severe and repeated bilharzial infections." Madden adds, "the mortality from Bilharziosis *per se* or its immediate complications was just over ten per cent; but this hardly gives one even an approximate idea of the real mortality, as many cases, when they do not appear to be improving, are taken out of hospital to die at home; all such cases are entered as unrelieved, but had they been left in hospital many of them would certainly soon have been included in the mortality tables." Professor Ferguson found that of a series of five hundred autopsies on male subjects eight per cent of all cases died of the effects of severe bilharzial infection.

In the course of the ankylostomiasis campaign during 1914-15 MacCallum obtained for the first time some exact and detailed information regarding the local incidence of vesical Bilharziosis in the provinces of Qaliubia and Sharqia. These results have not yet been published, but Dr. MacCallum very generously communicated

his statistics to assist the present inquiry. In Qaliubia, of 700 persons examined 44 per cent showed vesical Bilharziosis. In Sharqia, 66 per cent of the 1,089 patients attending the travelling hospital for ankylostomiasis at Minia el Qamh, and 70·9 per cent of 832 attending at Bilbeis showed Bilharzia eggs in the urine.

THE MOLLUSCA OF EGYPT.

The fresh-water molluscs of Egypt have been studied by a number of malacologists, and have been well described and illustrated, especially by Jickeli (1874) in "Fauna der Land und Süsswasser Mollusken Nord Ost Afrika's," by Bourguignat in various papers from 1863 to 1883, by Innes (1884) and Pallary (1909). The last writer, in his "Catalogue de la Faune Malacologique d'Egypte," summarizes very completely the work of previous collectors. Pallary's list (excluding land forms) is given in the adjoining table and in parallel columns are indicated: (*a*) Those species previously described in the works of Jickeli in 1879; (*b*) the species mentioned as having been examined as possible transmitters of Bilharzia in the writings of Lortet and Vialleton, Sonsino, and Looss, are marked respectively by the lettering "V." "S." "L."; and (*c*) the forms collected and examined in the course of the present inquiry. It will be seen that of the fifty forms catalogued by Pallary, Lortet and Vialleton mention only four, Sonsino specifies nine, and Looss eight. It will be noted that all the forms mentioned by Looss had been examined also by Lortet and by Sonsino. In the subjoining table is tabulated a complete list of the trematode larvæ hitherto found in Egyptian molluscs. A comparison of the finds of Sonsino and Looss shows that each investigator met with developmental forms overlooked by the others, and that the investigations of the present inquiry revealed a still larger number of new forms.

In the Natural History section of the magnificent "Description de l'Egypte" prepared by the authority of Napoleon during the French occupation in 1799-1801, eight of the commonest fresh-water molluscs are recorded and beautifully illustrated. In three of these we have found undoubted Bilharzia larvæ within half an hour's journey by tram and train from Cairo.

These are extraordinary facts in the light of Professor Looss's repeated contention during the past twenty years that he had examined hundreds of specimens of all the molluscs occurring in the Nile Valley without finding any developmental form which might have been brought into relation with the Bilharzia worm.

As every digenetic trematode hitherto investigated has been found to undergo its larval metamorphosis in a mollusc, the deductions made by Looss from investigations ranging over such a restricted part of the molluscan fauna of Egypt are entirely unwarranted. The conclusion of Lortet and Sonsino, that their inquiries had failed to reveal the essential invertebrate intermediary, was much more reasonable.

The Present Inquiry.

As the province of Qaliubia had been shown to be heavily infected with bilharziosis it was decided to make Cairo the head-quarters of the inquiry. It will be seen from fig. 1 that the province of Qaliub adjoins Cairo immediately to the north, lying between the eastern (Damietta) branch of the Nile on the west and the desert on the east, and is easily accessible by road and rail, being traversed by the highway and main line to Alexandria and their subsidiaries. At the request of Sir David Semple, Chief of the Public Health Department of Egypt, the vacant laboratories of the Professor of Parasitology in the School of Medicine in Cairo were kindly set apart for our use by the Director, and facilities for the keeping of experimental animals were provided at the Bacteriological Institute. The C.M.S. Hospital at Old Cairo constantly supplied fresh material for observation from their clinical cases. The programme of work laid down and consistently followed was :—

(*a*) To collect and specifically determine all the fresh-water molluscs in the selected endemic area, i.e., within half a day's journey from the laboratory in Cairo.

(*b*) To dissect large numbers of all species found for trematode larvæ.

(*c*) To differentiate among the larvæ found those showing the morphological characters peculiar to the bilharzia group.

(*d*) To ascertain which, if any, species of mollusc showed chemiotactic attraction for Bilharzia miracidia.

(*e*) To induce experimentally infection of animals brought from England with Bilharzia cercaria when found in the mollusc.

(*f*) To ascertain experimentally whether infection took place through the skin or by the mouth or in both ways.

(*g*) To ascertain experimentally the incubation period of the disease.

(*h*) To determine experimentally on infected animals the efficacy of medicines, reputed to be of value on clinical grounds, to destroy the bilharzia worms in the portal system.

EGYPTIAN SPECIES OF MOLLUSCA.

Pallary, 1909	Jickeli, 1874	S., V., L., 1892-94	W.O. Mission, 1915
(1) *Succinea cleopatræ*	+	..	+
(2) *Physa acuta*	+	V.	+
(3) *Physa subopaca*	−	..	+
(4) *Limnæa Caillaudi*	−	..	+
(5) (*var.*) *Raffrayi*	−	..	−
(6) *Limnæa alexandrina* (= *natalensis*)	+	S. L.	+
(7) *Limnæa truncatula*	+	..	?, +
(8) *Limnæa pharaonum*	+	..	+
(9) *Bullinus brocchii*	−	..	?
(10) *Bullinus Dybowski*	−	..	+
(11) (*var.*) *alexandrina* ..	−	S. L.	+
(12) *Bullinus Innesi*	−	S.	+
(13) *Bullinus* (*Isodora*) *truncatus* ..	−	..	+
(14) *Bullinus* (*Isodora*) *contortus* ..	+	..	+
(15) *Bullinus* (*Pyrgophysa*) *forskali* .. (= *Physa micropleura*)	+	S. L.	+
(16) *Planorbis* (*Menetus*) *boissyi* ..	+	..	+
(17) *Planorbis* (*Menetus*) *alexandrinus* ..	+	..	−
(18) *Planorbis* (*Menetus*) *poeteli* ..	+	..	−
(19) *Planorbis* (*Menetus*) *Laurenti* ..	−	..	+
(20) *Planorbis* (*Tropidiscus*) *philippi* ..	−	..	−
(21) *Planorbis* (*Gyraulus*) *Ehrenbergi* ..	−	..	?
(22) *Planorbis* (*Gyraulus*) *mareoticus* ..	+	S.	+
(23) *Planorbis* (*Segmentina*) *letourneuxi* ..	−	..	−
(24) *Planorbis* (*Segmentina*) *angusta* ..	+	..	+
(25) *Ancylus clessini*	−	..	?
(26) *Ancylus Isseli*	+	..	+
(27) *Ampullaria ovata*	+	..	+
(28) *Ampullaria kordofana*	−	..	−
(29) *Ampullaria lucida*	−	..	−
(30) *Ampullaria exigua*	−	..	−
(31) *Ampullaria vitrea*	−	..	−
(32) *Lanistes bolteni* (*carinatus*) ..	−	V. L.	+
(33) *Vivipara unicolor*	+	S. V. L.	+
(34) *Vivipara biangulata*	−	..	+
(35) *Cleopatra bulimoides*	+	S. L.	+
(36) *Cleopatra vexillata*	−	..	−
(37) *Cleopatra verreauxi*	+	..	−
(38) *Cleopatra cyclostomoides*	−	S. L.	+
(39) *Bythinia goryi*	+	..	−
(40) *Bythinia alexandrina*	−	..	−
(41) *Bythinia letourneuxi*	−	..	−
(42) *Bythinia pseudamnicola*	−	..	−
(43) *Bythinia subbadiella*	−	..	−
(44) *Bythinia* (*Gabbia*) *sennaarica* ..	+	..	+
(45) *Hydrobia erythræa*	+	..	−
(46) *Hydrobia stagnalis*	+	..	−
(47) *Hydrobia* (?) *schweinfurthi* ..	+	..	−
(48) *Melania tuberculata*	+	S. V. L.	+
(49) *Valvata nilotica*	+	..	+
(50) *Neritina nilotica*	+	..	−

(*i*) To observe the conditions favourable and inimical to the life of the free-swimming cercaria and the effect thereon of acid solutions and other medicinal substances.

(*j*) To study the bionomics of the special molluscan intermediary, if obtained, for facts upon which prophylactic measures could be formulated.

An examination of the banks of the Nile to the south of and around Gezireh, an island opposite Cairo, showed that, excluding bivalves, there were very few living forms in the main stream. Similar results followed from an examination of the Ismailia Canal at Mataria, north of Cairo, and of the Giza Canal, on the western bank of the Nile.

A study of a map of the environs of Cairo showed that there was a large number of collections of water in the Zoological and Botanical Gardens at Giza. With the permission of the Director, Major Flower, these ponds were exhaustively examined and were found to contain nearly all the described species of molluscs, with one or two notable exceptions. With material from this source a type collection of molluscs was made so that specimens brought in later from infected areas could be rapidly compared and determined.

In the report of the ankylostomiasis campaign in Qaliubia it was noted that a small travelling hospital had been stationed at the village Qalama, thirteen miles north of Cairo and near the main road to Alexandria (fig. 1). Of ninety-five inhabitants of this village, forty-three had been found to harbour bilharzia. This small village seemed, therefore, at first sight, a suitable place in which to make an intensive study of the local molluscan fauna. It proved, however, more difficult of access than had been anticipated. There was, too, a very large pond or birket which could not be thoroughly examined. Finally, as will be noted from the map, the canal outskirting the village had passed through a number of other villages after it took off from the main stream. Infection acquired in Qalama might well have been due to infective larvæ carried on from a higher part of the canal, and not actually derived from molluscs at Qalama itself. It was consequently decided to seek a more suitable village, if possible (*a*) of easy access, (*b*) without a birket, and (*c*) on a small canal coming almost directly off one of the main supply canals.

El Marg and the Marg Canal.

In the meantime, the Arab who had been for many years attendant in the Department of Parasitology had volunteered to bring snails from a place where he had been in the habit of

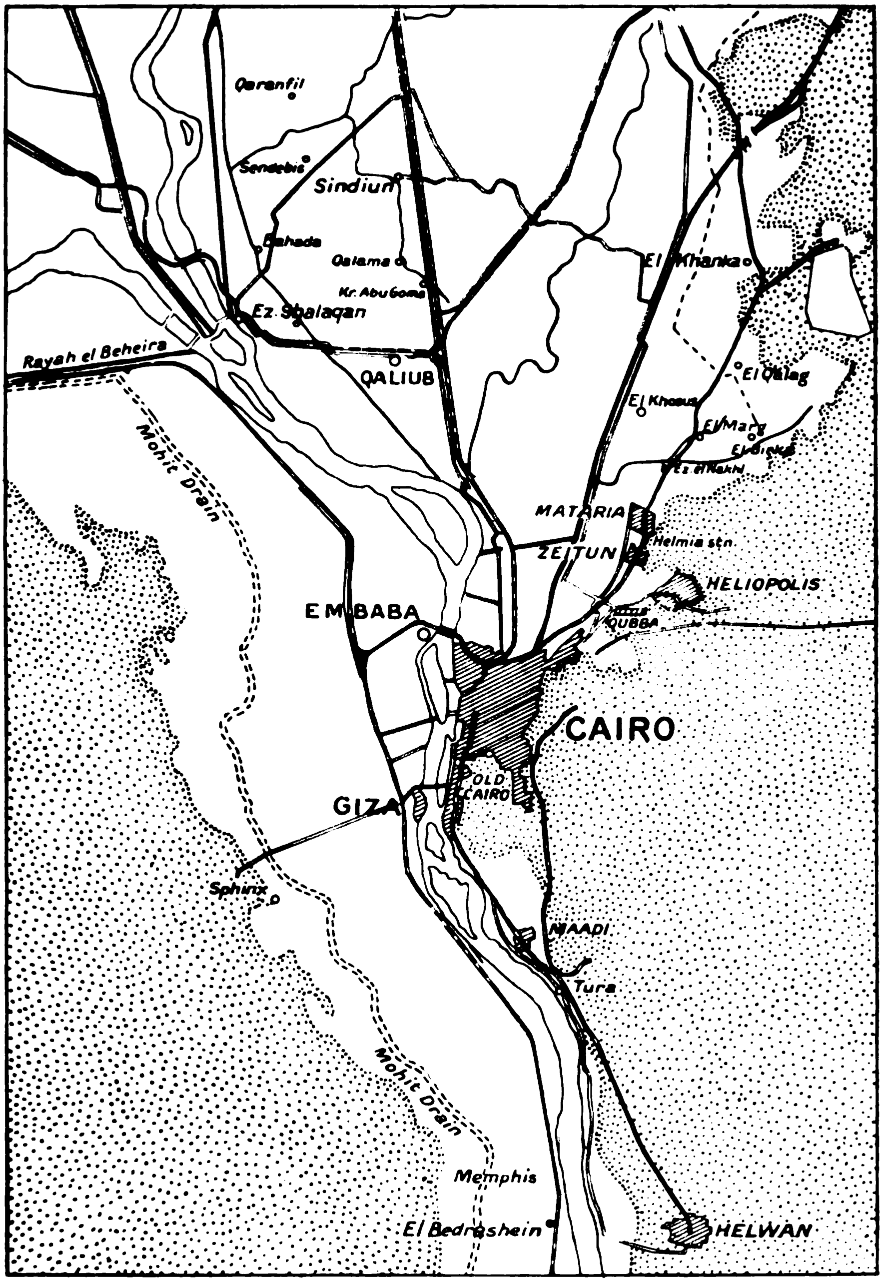


FIG. 1.—Cairo and the outlying villages.

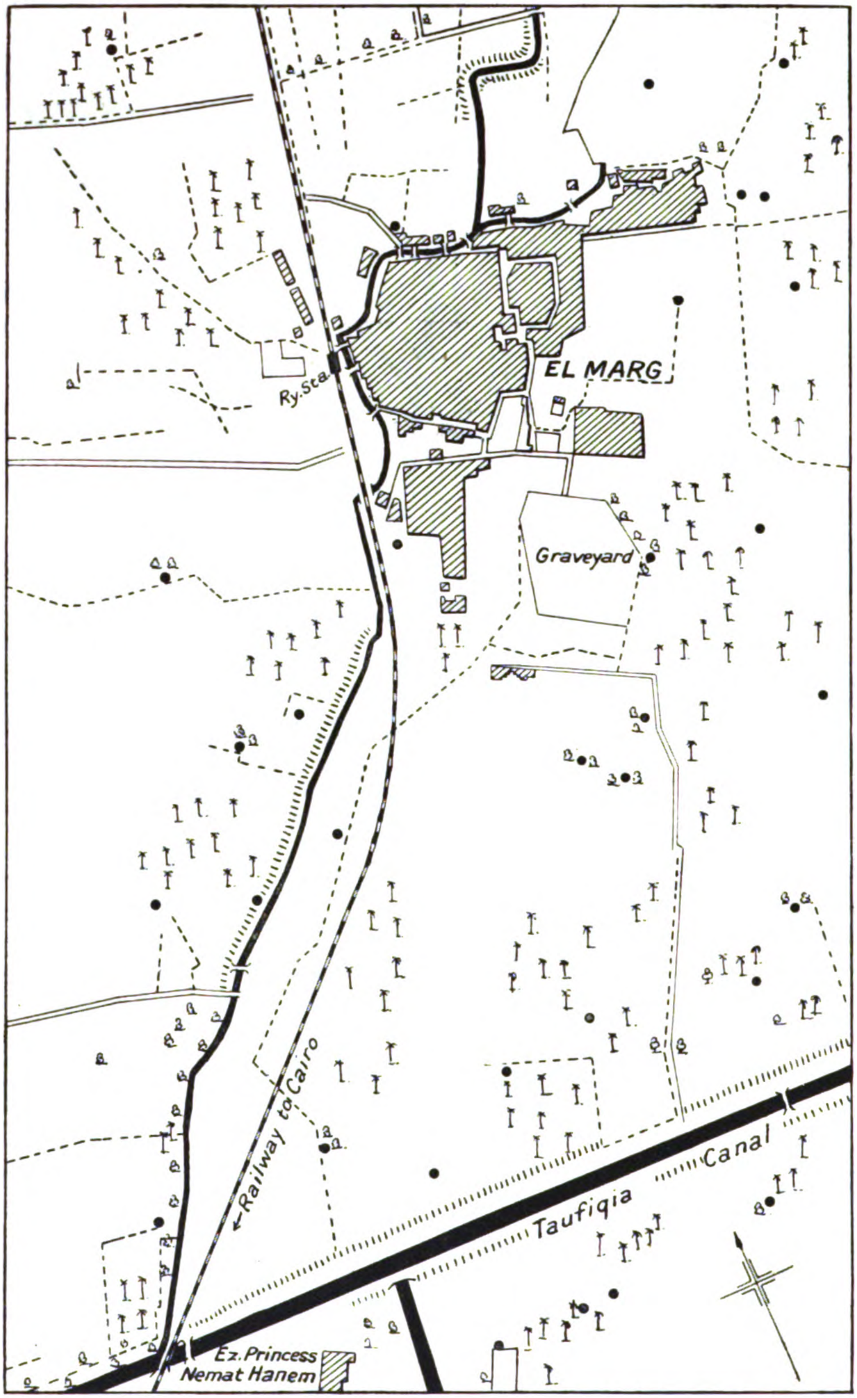


FIG. 2.—El Marg and the Marg Canal.

collecting them for the purposes of the class in zoology. His finds were both numerous and varied, and it was decided to prospect this collecting ground. It proved to be at his own village, El Marg, some nine miles north of Cairo, just beyond the popular and rapidly extending northern suburb of Cairo on the Zeitun-Mataria line. There was a good half-hourly train service, the village lay alongside the railway line and was an agricultural centre, being surrounded

FIG. 3.—Children from Marg village collecting water for domestic use.

by cotton fields and date palm groves. There was no birket, the only water supply to the surrounding fields was a small tertiary canal which traversed the village and derived its supply from the main Ismailia Canal a few miles distant, not far from its origin from the Nile. The village has a population of less than 5,000 and its inhabitants are mainly occupied in cultivating the surrounding land.

As will be seen from fig. 1, El Marg is situated in the centre of a cultivated plain, roughly triangular in shape, having as its base the Ismailia fresh water canal which runs north from Cairo, and

limited on the other two sides by desert. From the irrigation standpoint this triangle forms a small unit, the incoming water being drawn from the Ismailia Canal, mainly by the secondary Taufiqia Canal, which can be seen running eastward north of Mataria through Ez-el-Nakhl, where it is crossed by the railway from Cairo to El Khanka, and passing on through El Birka. The water from this canal and its subsidiaries, such as the El Marg Canal, after irrigating the land, drains into the large Bilbeis

FIG. 4.—Women washing garments in Marg canal.

drain, which runs northward from El Birka past El Qalag to Bilbeis, and is indicated on the map (fig. 1) by a broken line. The El Marg Canal takes off from the Taufiqia Canal near Ez-el-Nakhl station, and the flow is here controlled by an iron regulator. For about a mile the canal runs northwards parallel to the railway line, and on either bank there is a much frequented footpath. Just before the Marg railway station is reached, the canal passes under the line. At and above this point are the favourite spots from which the women and children carry water daily into the village for domestic use (fig. 3). After piercing

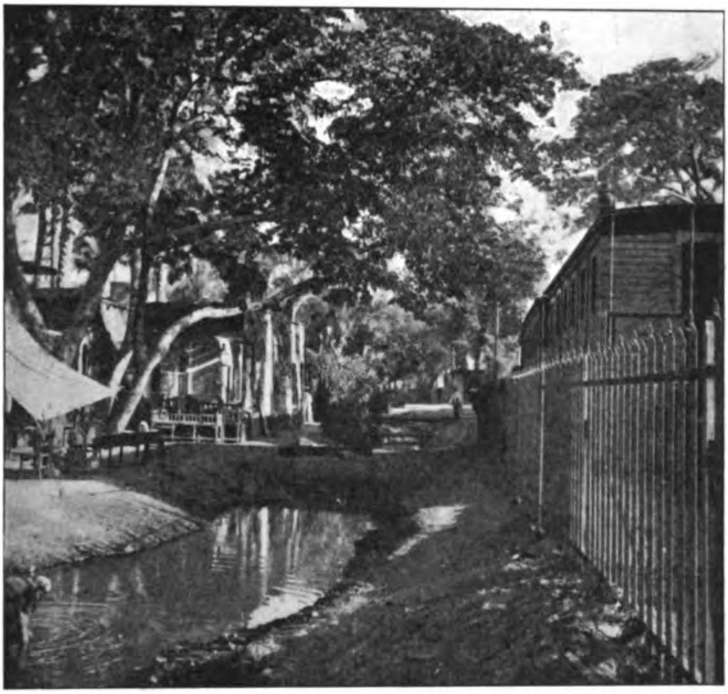


Fig. 5.—The canal skirting the village between the railway station and the cafés.

Fig. 6.—Marg bridge, crossing the canal from the station.

Fig. 7.—The canal forming a shallow pool in the village square.

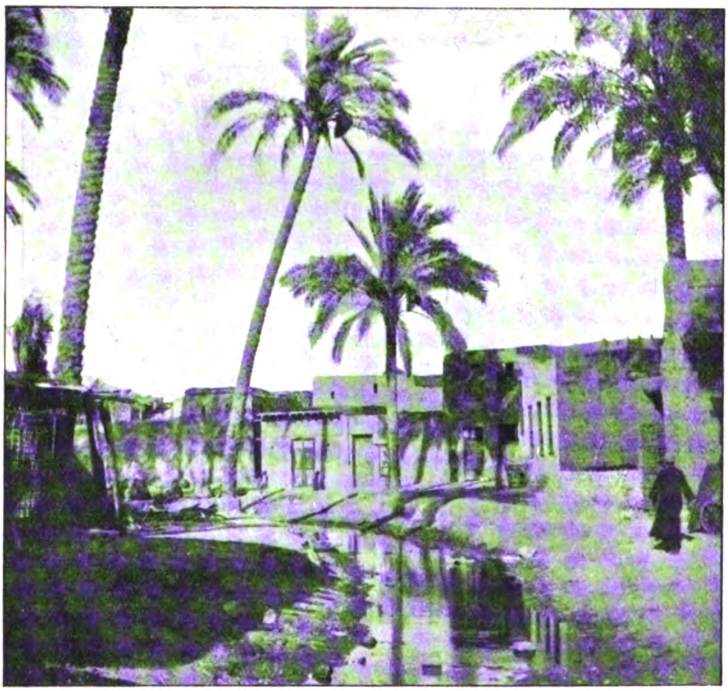


Fig. 8.—Marg canal running northwards through the village.

Fig. 9.—The Marg Canal traversing the date palm grove.

Fig. 10.—Marg Canal entering the cotton fields north of the village.

the railway embankment the canal continues alongside the line for about one hundred yards. This reach is much frequented by women for the purpose of washing clothes (fig. 4). The canal now skirts the houses, shops and cafés which front the railway station, and is open to constant contamination (fig. 5). A short wooden bridge crosses the canal at the station (fig. 6). Here the stream bends towards the centre of the village and forms a wide

FIG. 11.—A cul-de-sac in Marg canal dry during the " rotations."

shallow pool (fig. 7). Turning northwards again between two rows of houses, and with paths on either bank (fig. 8), it laces through a date-palm grove (fig. 9) and reaches the open country, where it rapidly diminishes (fig. 10) and ultimately divides into a number of small canals supplying the individual fields.

INCIDENCE OF BILHARZIOSIS IN MARG.

In the historical section reference was made to the frequent occurrence of bilharziosis among the French troops during the invasion of Egypt in 1799-1801, and it is of interest that the little village Marg was the site of one of the battles in 1799.

No statistics of the occurrence of bilharzia in this village were obtainable. A rapid examination of the urine of fifty-four boys in two of the village schools showed bilharzia eggs in forty-nine cases. The determinations were completed within an hour, and the positive results based upon single drops of freshly passed urine taken without either sedimentation or preliminary use of the centrifuge. Most of the boys were under 12 years of age, and had been born and reared

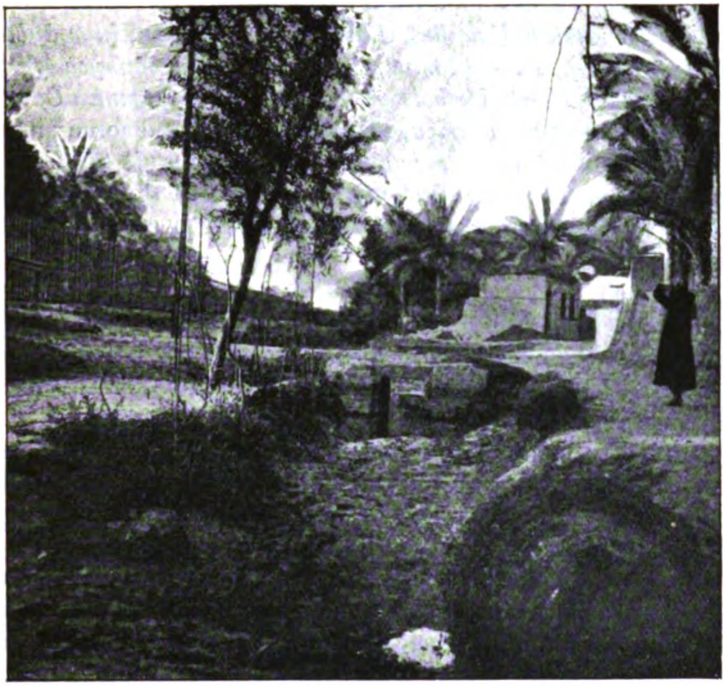


FIG. 12.– Marg Canal almost dry during a summer rotation.

in the village. It seemed reasonable to suppose that the bilharzia infection was derived from the Marg Canal, with its terminal branches and subsidiary agricultural drains around the village. It was decided, therefore, to make a complete census of all fresh-water molluscs in this the sole possible source of infection.

THE MOLLUSCA OF MARG.

A fortunate circumstance enabled us to make practically certain that no species living on or in the muddy bottom of the canal was overlooked. During the summer months the water coming from

the main canal is entirely controlled by the Government, and is supplied on a definite rota of six days' flow, succeeded by fifteen days' stoppage, in every three weeks. This rotation began early in April. During the fifteen days' stoppage the water entirely disappeared from the Marg Canal (fig. 11), save where inequalities left small puddles (fig. 12), and we were able to collect stranded shells throughout its length from the drying surface and to recover by sieving those forms that had succeeded in burrowing for some distance into the mud. The species found were : *Melania tuberculata, Vivipara unicolor, Cleopatra bulimoides, C. cyclostomoides, Bullinus dybowski, B. alexandrinus, B. contortus, B. innesi, Pyrgophysa forskali, Lanistes bolteni, Planorbis boissyi, P. mareoticus, Limnæa Caillaudi, Bythinia* (*Gabbia*) *sennaarica, Valvata nilotica* and some bivalves.

The commonest species were *Planorbis boissyi, Bullinus* and *Cleopatra, spp.*, the two first-mentioned being the most obvious forms on account of their habit of seeking the surface for air.

TECHNIQUE.

The various molluscs, wherever and whenever collected, were separated into their different genera and, as far as possible, species, and examined for developmental stages : (*a*) by direct inspection, (*b*) by dissection. When an infected mollusc is kept in a glass vessel in clean water for a few days the cercarial forms are frequently discharged naturally by the mollusc, and may be easily seen swimming about in the water if the glass is held against the light and examined with a hand lens. By this method large numbers of the same species can be placed together in a vessel and tested without further technique. If, however, the larval development has not yet reached the stage for the discharge of the cercaria the results are apt to be misleading. Should a positive result be noted, the cercaria can be determined by microscopical examination and the infected mollusc isolated and kept alive for further observation. By dissection the earlier stages (sporocyst, redia, and immature cercaria) are obtained. The method has the disadvantage that the mollusc is necessarily killed in the course of the dissection and cannot be used for further work. The technique is simple though tedious when large numbers are involved. The shell, when hard and calcareous as in Cleopatra and Melania, is crushed with lion forceps, placed on a slide in a drop of water or weak formalin and the mass then torn apart with two dissecting needles. With the thin-shelled forms like Planorbis it suffices to fix the shell by piercing the central whorl with one

needle and to cut outwards with the second. In our experience the spear-shaped steel points issued for use on gramophone records when fixed in needle-holders are far more satisfactory than ordinary dissecting needles for this work. With them a large window can be quickly cut in the hardest shells and the molluscan body rapidly dragged out complete. The liver, which occupies the upper or central whorls of the gastropod shell, is the usual site of election for the developmental stages of trematodes. But a detailed examination of the mollusc is practically never necessary for the determination of an infection. With the first tear, as a rule, the characteristic bodies flood out in numbers into the surrounding plasma and water, while further search may be made under a low power by squashing the whole molluscan body slightly between two slides. In this way over 3,300 samples were minutely examined in the course of the inquiry. As shown in the appended list, seventeen species of Trematode larvæ were identified during these dissections. A number of new species were found also.

List of Trematode Larvæ identified in Egyptian Molluscs.

Molluscan host	Name of larva	Sonsino 1892	Looss 1896	Leiper 1915
Cleopatra	(1) *Gastrodiscus ægyptiacus*	–	+	+
	(2) *Cercaria distomatosa*	+	+	+
	(3) *Cercaria vivax*	+	+	+
	(4) *Cercaria exigua*	–	+	+
	(5) *Cercaria microcotyla*	+	–	+
	(6) *Cercaria capsularia*	+	+	–
	(7) *Cercaria cristata*	+	–	+
Limnæa	(8) *Cercaria obscura*	+	–	+
Bullinus	(9) *Cercaria pigmentata*	+	+	+
	(10) *Cercaria agilis*	+	–	+
	(11) *Cercaria fissicauda*	+	–	+
B. (Pyrgophysa)	(12) *Cercaria pigmentata*	+	+	+
Melania	(13) *Cercaria pleurolophocerca*	+	+	+
	(14) *Cercaria cellulosa*	–	+	+
	(15) *Cercaria monostomi verrucosum*	–	+	+
	(16) *Cercaria microcristata*	+	–	+
	(17) *Cercaria microcotyla*	+	–	+
Vivipara	(18) *Cercaria pusilla*	–	+	+
Lanistes	(19) *Cercaria sp.?*	–	?	+

Recognition of Bilharzia Cercaria.

The adult bilharzia worm resembles the other distome trematodes in possessing well-developed oral and ventral suckers, but differs in two remarkable ways: the sexes are separate, and there is an absence of a definite muscular pharyngeal bulb at the commencement of the œsophagus (fig. 21). As in all parasitic worms the infective

stage shows no sexual differentiation, consequently the absence of pharynx in the cercaria (fig. 19) is the one reliable character upon which a bilharzia cercaria can be distinguished from the cercariæ from other distomes, because the body of the cercaria without further metamorphosis grows to become the body of the adult worm. All cercaria have a motile tail at the posterior end. This appendage is a purely larval structure both morphologically and functionally. It serves the definite object of enabling the cercaria body to travel from the intermediate host to some favourable position where it can gain entrance to the final host. The tail is always shed before the actual arrival of the cercaria in the tissues of its host. Various cercaria exhibit different types of caudal appendage. In the four bilharzia cercaria that have come under the notice of the writer the tail was forked at its free end. This peculiarity, however, is shared with some other widely different forms among the distomes. It will be shown in the latter part of this report that four distinct sub-groups of bifid-tailed cercaria occur in the mollusca of Egypt.

Attraction of Mollusca for Bilharzia Miracidia.

Looss states that none of the Egyptian mollusca exhibited the slightest attraction for the freshly hatched miracidia of bilharzia. Most of the species submitted to experiment by us were entirely ignored by the miracidia. A definite attraction, however, was exhibited by the following: *Planorbis boissyi*, *Bullinus sp.* (?), *Pyrgophysa forskali*, and *Limnæa truncatula*. The attraction was stronger in young specimens. This plurality of susceptible forms appeared to indicate the possibility of a plurality of intermediate hosts or the susceptibility of the *Bilharzia hæmatobia* miracidia to the intermediate hosts of other species of bilharzia, or merely, as seemed probable in *Limnæa truncatula*, to a peculiar adhesiveness of the mucus covering the exposed portion of the mollusc body.

It may be noted here that not a single specimen of *Limnæa truncatula* could be found in or around Marg.

Marg Molluscs found infected with Bilharzia.

Large numbers of snails collected from the Marg Canal throughout its course, but more especially within the village, were infected with larval forms showing the morphological peculiarities of the bilharzia group. The infected shells were readily obtained at spots daily frequented, such as the praying ground at the embankment

crossing (fig. 11), in front of the cafés (fig. 5), and at a bend in the canal specially used for washing, which is illustrated in fig. 10.

The same species of mollusc was quite common at some distance from the village in the agricultural drains away from foot-paths, but was not infected. Nearer the village, however, and especially where crossed by public paths, these drains contained infected snails (fig. 13). So far the molluscan intermediary has

Fig. 13.—A typical agricultural drain on the outskirts of Marg, containing infected snails.

not been found in birkets, but it occurs not uncommonly in large marshes such as that, lying to the south-west of Ismailia, which is illustrated in fig. 14.

Once a bifid-tailed cercaria has been placed in the bilharzia group on account of the absence of pharyngeal bulb, further determination of its systematic position can only be effectively established in the first instance by experimental infection of a susceptible host and the subsequent examination of the adult worm resulting therefrom.

Attempts to Infect Animals Experimentally.

Three cercariæ of bilharzial type were found in four different species of molluscs. The first form met with differed considerably from the other two, more especially in possessing a pair of black pigment spots just anterior to the ventral sucker, and a delicate but well-defined cuticular expansion on each side of the two prongs of the bifid tail. This form was found exactly five weeks after the

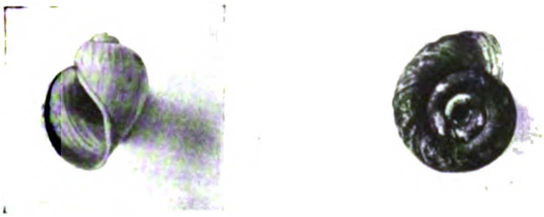
Fig. 14.—Marsh, near Kosti village, south-west of Ismailia.

commencement of our search, and occurred in *Planorbis mareoticus* collected from the ponds in the Zoological Gardens at Giza. Apparently identical cercariæ were found later at Giza and Suez in *Melania tuberculata*, and at Ismailia in *Planorbis boissyi*. The second bilharzia cercaria occurred in large numbers in *Planorbis boissyi* at El Marg, and was found later in similar canals between Inshas and Bilbeis in the Sharqia province. A very few cercariæ, apparently identical with this, were recovered on one occasion only from a *Melania tuberculata* in the Zoological Gardens. A third

cercaria, which on morphological grounds was only provisionally distinguished from that occurring in *Planorbis boissyi*, was also found at Marg in a certain number of specimens of *Bullinus* (fig. 15, A).

At Marg the *Planorbis boissyi* (fig. 15, B) were so commonly infected with non-eyed *Bilharzia cercaria* that half-an-hour's collecting sufficed to ensure a large supply of active larvæ. An extended series of experiments was instituted to determine the specific character of these forms.

Three species of *Bilharzia* worms are supposed to occur in Egypt: In man the *Schistosoma hæmatobium* (both varieties), in cattle the *S. bovis*, and in ducks the *Bilharziella polonica*. As bifid-tailed cercariæ with eye spots have been found, though not identified, in snails both in Central Europe and in North America, and as this cercaria departed somewhat from the two other forms, it seemed a reasonable conjecture that this cercaria was the larval



A B

FIG. 15.—A, *Bullinus cortortus*; B, *Planorbis boissyi*.

stage of an avian *Bilharzia*, and that the two remaining and similar cercariæ probably attained their maturity in the two known mammalian hosts. Attempts were made to verify this conjecture experimentally. In order to exclude possible fallacies it was essential to infect ducklings immediately after hatching and before they had come in contact with other than filtered water. These were obtainable in Cairo.

One was struck by the apparent entire absence of rats in the banks of the canals and in the fields. The authorities at the Giza Zoological Gardens stated that the common water-vole does not occur in Egypt. A professional rat-catcher was commissioned to obtain rats and field-mice from around Marg. His search proved quite fruitless. It was possible that this extraordinary absence of rodents might be due to a susceptibility to Bilharzia disease.

The animals frequenting the canal at Marg were man, cattle,

sheep, dogs (possibly rats), geese, ducks, chickens, and crows. Man and cattle were the most obvious sources of contamination of the canal water, and as each was a known host of species of *Bilharzia*, the probabilities were that cercaria normally developed in them.

Attempts to infect a calf and a lamb by allowing water heavily charged with the living cercaria to remain in the hollows of the groin for periods of ten to thirty minutes on several days gave entirely negative results at the post-mortems some weeks later. It was noted, however, in the case of the lamb, that the skin, where repeatedly exposed to infection, became markedly red.

A series of experiments was then made on mice, rats, geese, ducks, chickens, crows, and wagtails. The experiments on the birds proved entirely negative.

A positive result became apparent by June 13 in a young white rat, which had been infected on May 4. A black mouse which had been infected on May 2 died on June 24 with a number of Bilharzia worms in the liver and mesenteric veins.

In these early successful infections the mice and rats died from the occlusion of the portal system before the Bilharzia worms had reached sexual maturity. A comparative study of mature specimens of *Schistosoma bovis* and *S. hæmatobium* showed that these two species are so closely allied that, when experimentally reared in an abnormal host, a differential diagnosis could only be made with certainty upon the characters of the fully grown worms, and especially upon those of the egg shell. Further experiments were made. In those animals which survived for seven to eight weeks, female worms were found containing the characteristic eggs (fig. 20). This placed the diagnosis beyond question.

The animals used were variegated mice and white rats brought from London and fed solely on oats and filtered water. They had been kept in the laboratory under conditions entirely precluding the possibility of unobserved infection.

Animals found Susceptible to Infection.

In addition to tame white rats and variegated mice, the Egyptian desert rat, obtained from the neighbourhood of the Pyramids, was found to be susceptible to experimental infection, while guinea-pigs were peculiarly so. Mangaby monkeys died of acute bilharziosis within two months of infection. Experiments were not made on dogs owing to the quarantine difficulties that would have arisen on our return to England. At the conclusion of its field work the Mission

FIG. 16.

Edge of liver of mouse experimentally infected with bilharzia.

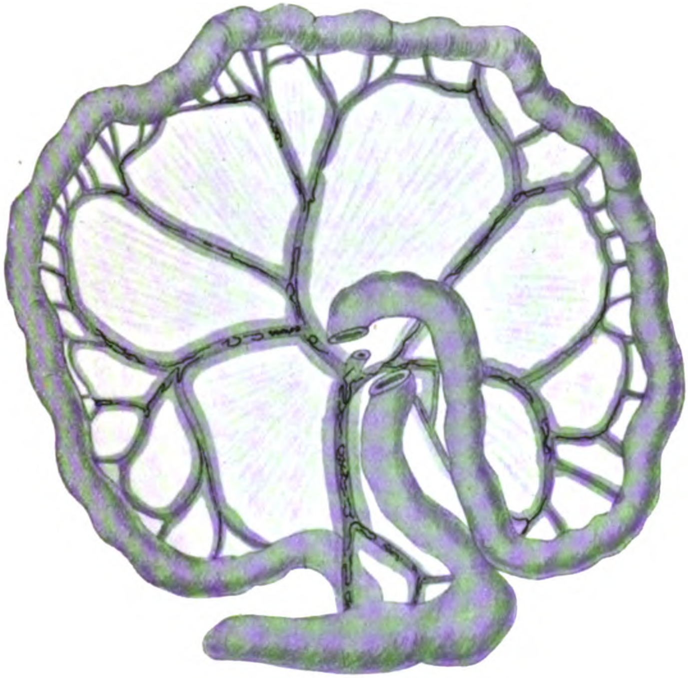


FIG. 17.

Mesentery of mouse experimentally infected with bilharzia.

To illustrate "Report on the Results of the Bilharzia Mission in Egypt, 1915," by Temporary Lieutenant-Colonel ROBERT T. LEIPER, D.Sc., M.B., R.A.M.C.

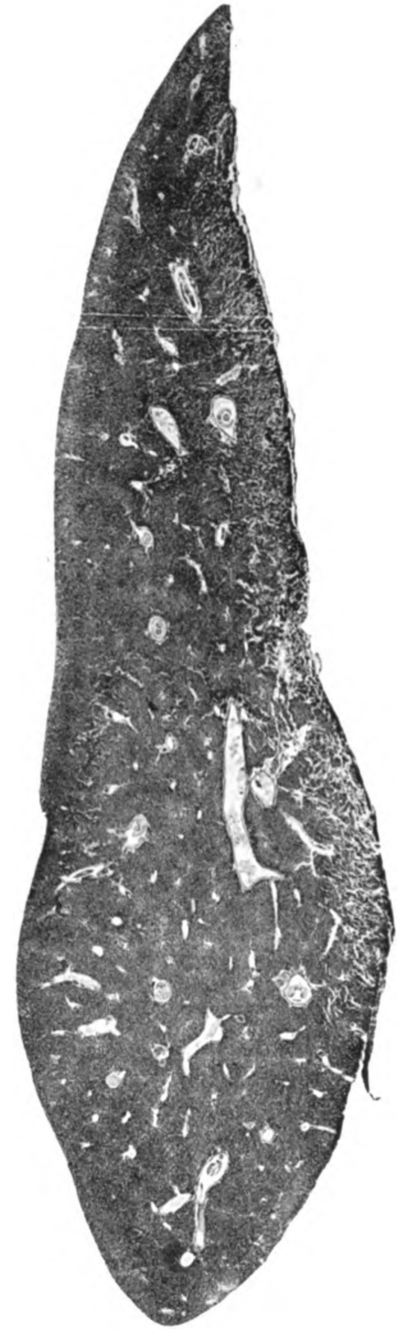


FIG. 18.

Section of liver of white rat experimentally infected with bilharzia showing veins blocked by worms.

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brought back from Egypt four mice, twenty-six white rats, sixteen desert rats, two guinea-pigs, and four mangaby monkeys, which had been submitted to infection shortly before departure. When examined shortly after their arrival in England all these animals had enormous numbers of bilharzia worms in the portal system.

Effect of Weak Acid and Alkali on Living Miracidia and Cercaria.

The theory that Bilharzia infection takes place through the skin was put forward by various South African writers from Harley to Brock, because in their clinical experience infection was found to follow repeatedly upon bathing in heavily contaminated waters. Looss, on the other hand, adopted the view because weak acids were found to kill the miracidium and consequently this, his hypothetical infective agent, could not survive in the stomach when taken in drinking water. The favourable action of weak alkalis and the destructive effect of dilute acids on all cilia is one of the recognized exercises in practical physiology. That alkalis and acids should have a similar effect on the ciliated body of the miracidium may be regarded therefore as a foregone conclusion. It does not necessarily follow, however, that the same result would obtain in the case of cercaria which are covered with a cuticular skin. Experiments were undertaken therefore to ascertain exact information on this point. Looss and others have shown that miracidia are killed immediately by a dilution of 1 in 2,000 of hydrochloric acid. Cercariæ withstand hydrochloric acid 1 in 880 for five minutes; 1 in 500 kills Bilharzia cercaria immediately. The acidity of the stomach would therefore inhibit these cercaria. This does not exclude the possibility, however, that infection may take place through the mouth. The ankylostomes and strongyloides infect through the mouth as well as through the skin. Fülleborn has recently shown that when the strongyloides are taken in by the mouth they do not pass on directly in the lumen of the gut into the small intestine, but penetrate the wall and, gaining the blood-stream, follow the circuitous route through the lungs up the trachea and then pass for a second time down the œsophagus through the stomach to the small intestine.

Mode of Entry of Bilharzia into the Body.

That something similar to this might occur in Bilharzia was suggested by a simple observation on the habits of the Bilharzia cercaria. These cercaria progress by swimming mainly through the

activity of their tails or by creeping by means of their well-developed suckers. When actively swimming cercaria are poured from one dish into another it is very noticeable that they immediately fix themselves firmly by means of their ventral suckers to the surface of the vessel into which they are carried until the motion of the water has ceased, when swimming is again resumed. It seemed, therefore, quite possible that if heavily infected water was drunk, the cercaria, coming into momentary contact, might similarly adhere to the mucous membrane of the mouth, tongue and œsophagus and at once proceed to penetrate into the tissues. That this actually can take place is apparently borne out by the following experiment. Four sooty monkeys which had been taken out with the Mission in January and kept in separate cages in the laboratory until the experiment was completed, were subjected to infection with Bilharzia cercaria. In three cases the infected water was poured into the bottom of the cages and the monkeys were consequently exposed to infection through the skin of the hands, feet, buttocks and tail. The fourth monkey was fed for a day or two on dry food only, and then allowed to drink from a cup containing food and water swarming with Bilharzia cercaria. Some effect, probably a prickly sensation, was produced almost immediately, for the monkey began to pull down the lower lip, to rub the mucous membrane of the mouth, and in other ways to indicate that the drink had not been pleasurable. After a second experience on the following day the monkey refused to accept water out of a cup although thirsty. The four monkeys eventually died and all showed a heavy infection with Bilharzia. The monkey infected from drinking water showed earlier and much more intense symptoms than the others. This experiment showed that in Bilharzia infection may be both oral and cutaneous. As in ankylostomiasis there is little doubt, however, that the infection enters through the skin in the bulk of cases.

As Brock [67] has pointed out, the chances of infection are much greater in bathing than in drinking, because under the former circumstances a much larger quantity of water comes into contact with the body.

Incubation Period of the Disease.

The incubation period of Bilharzia has been variously estimated by different writers. Sonsino gives from two to three years. Sandwith considers that it ranges from three to six months.

Hatch [222] in 1887 wrote : " The time between the contraction

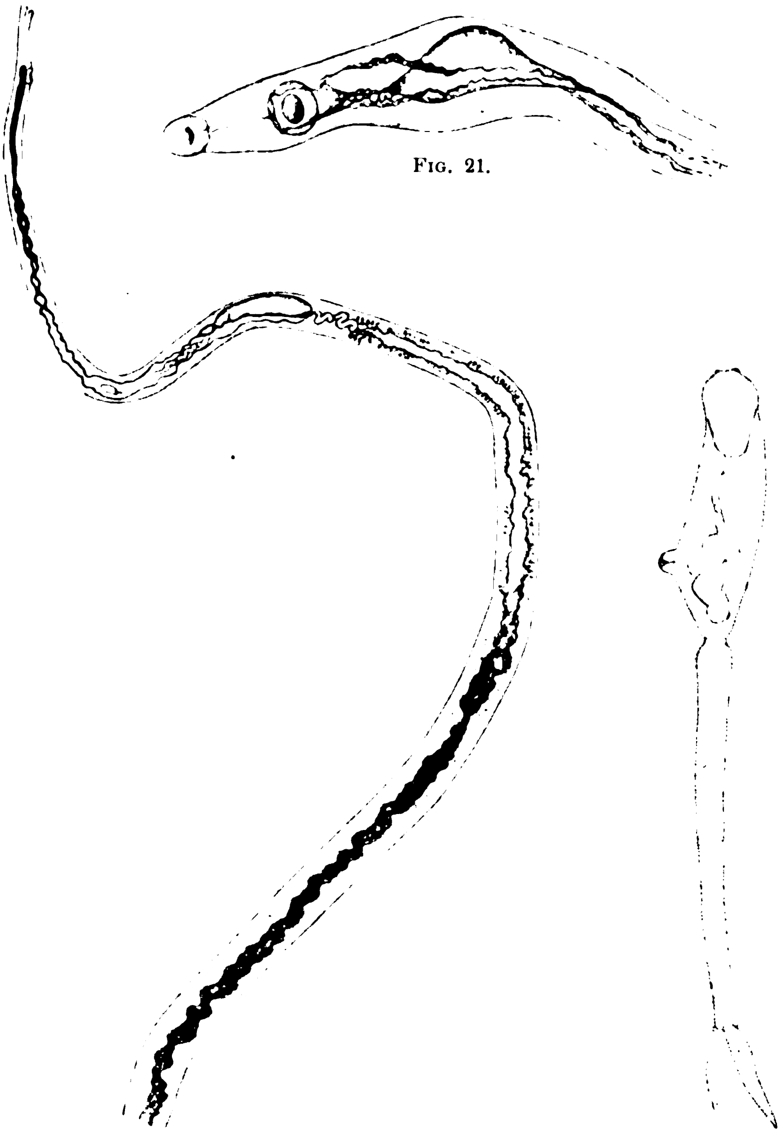

FIG. 21.

FIG. 20.

FIG. 19.

Fig. 19.—Cercaria of Bilharzia used in experiment. x 200.
Fig. 20.—Adult female taken from portal vein of mouse, experimentally infected mouse. x 18 (circa).
Fig. 21.—Anterior portion of adult male taken from the same source. x 18 (circa).

To illustrate "Report on the Results of the Bilharzia Mission in Egypt, 1915," by Temporary Lieutenant-Colonel ROBERT T. LEIPER, D.Sc., M.B., R.A.M.C.

of the disease and the passage of blood and other symptoms may be very short; one patient, who stayed at an hotel at Suez for fourteen days, suffering from them a month after his return to Bombay." More extensive observations were made during the South African War. Beveridge [24] gives the following valuable table in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for 1907:—

Case	Age	Service year	Date of arrival in South Africa	Date of reporting sick with Bilharzia ova in the urine	Interval between arrival and reporting sick	Remarks
1	20	1	9.11.02	1.2.03	12 weeks	
2	20	1	9.11.02	17.2.03	14 ,,	
3	20	1	9.11.02	6.2.03	4 months	
4	21	1	9.11.02	19.3.03	4 ,,	
5	20	1	9.11.02	20.3.03	4 ,,	
6	23	3	9.11.02	6.7.03	7 ,,	Gives a history of 4 months' duration.
7	16	1	4.12.02	19.6.03	6½ ,,	Gives a history of 3 days' duration.

In the same year Dr. Stock [475] wrote: "The time which elapses between its entrance and the onset of symptoms seems to be settled from the observations of Dr. Abercrombie. During the time that the regiment was at Pretoria several young drafts were sent out direct from England and all in due course bathed in the spruit, and as a result several cases occurred in young soldiers whose residence in the country had not been more than two months. The shortest period observed was one month, and the longest two months."

A similar incubation period occurred in the monkeys infected by us experimentally. Monkey No. 1, infected by immersion on June 15, 17, 24, and July 11, passed bilharzia eggs on August 4 and died on August 18. Monkey No. 2, immersed on June 17, 20, 23, and July 11, passed blood and mucus containing bilharzia eggs on July 30 and died August 9. Monkey No. 3, immersed June 17, 20, 23, and July 11, showed bilharzia ova in the wall of the large intestine after death on August 2. Monkey No. 4 drank infected water June 24, and on other occasions, including July 11, passed schistosome eggs and blood on August 4 and died of acute bilharziosis on August 8.

OCCURRENCE OF BILHARZIOSIS IN LARGE TOWNS.

There is one argument brought forward in his numerous papers by Professor Looss which seems at first sight to lend real support to his view that the mollusc is not required for the bilharzia

worm; that is, the accepted occurrence of bilharzia infection among children born and bred in large towns such as Cairo, where there is a filtered water supply.

Looss states that 33 per cent. of the boys attending a school in Cairo showed bilharzia eggs in the urine, and in 1908 Mrs. Elgood [158] showed that out of forty girls aged 12 to 16 in a middle-class school in Cairo, 11 (i.e., 27·5 per cent) were infected. These girls with one exception had lived all their lives in Cairo. None had ever bathed in the Nile or a canal, nor had any ever run about

FIG. 22.—Courtyard of Department of Physical Science, Cairo, showing supply of unfiltered water pumped direct from the Nile.

bare-legged in fields or country roads. The general water supply in Cairo is the same for natives as for Europeans, is of high quality and is supplied from the filters of the Cairo Water Company. These facts have been repeatedly used by the supporters of the Looss hypothesis, and certainly if correct could scarcely be otherwise explained.

After some inquiry the following facts came to light, which seemed to afford a simple and adequate reply to this objection. In

addition to the series of pipes supplying Cairo with filtered water, it appears that there is a second system carrying to the numerous gardens of Cairo unfiltered water drawn direct from the Nile in the neighbourhood of the Kasr Nil bridge, a spot where, in recent years, numbers of European troops have, while bathing, become infected shortly after their arrival in Egypt. It is well known that the children, even of the better-class Egyptians, are allowed to run about in the privacy of their own courtyards in a state of semi-nudity during the summer months, and are thus continually exposed to the risk of infection from the hose used in the garden or stable. The lower classes probably derive their infection from the same source, although under different circumstances. To them water is a dear commodity in Cairo. There is no free supply. In the poorer quarters one frequently sees water being hawked about in large skins, and there is the standing inducement to the middleman to increase his margin of profit by arranging to draw his stock, possibly surreptitiously through a friendly gardener, from the unfiltered supply for which the water companies make a lower charge. At Ismailia there is a dual supply of filtered and unfiltered water into the houses, the latter being laid on to the bathroom and kitchen and supplied at a lower rate. A standard pipe from the unfiltered supply in Cairo is shown in fig. 22 from a photograph taken in the courtyard of one of the Government offices.

Conclusions Contrasted.

Conclusions based on the Looss Hypothesis.

(1) All transient collections of water, such as those resulting from occasional showers of rain, road waterings and domestic waste, are dangerous if freshly contaminated.

(2) Large bodies of water, such as the Nile, canals, marshes and birkets, are little liable to be infective.

(3) All water in a given area would automatically become safe in thirty hours if the native infected population were removed.

(4) Infected troops would be liable to reinfect themselves, to spread the disease among other troops, and to convey the disease to any part of the world.

(5) Infection only takes place through the skin.

(6) Infection in towns is due to contact with recently contaminated moist earth or water.

(7) Eradication depends upon education and complete sanitary control throughout the country. The sustained co-operation of the affected individual is essential.

Conclusions based on the Results of the Present Inquiry.

(1) Transient collections of water are quite safe after recent contamination.

(2) All permanent collections of water, such as the Nile, canals, marshes and birkets, are potentially dangerous, depending upon the presence of the essential intermediary host.

(3) The removal of infected persons from a given area would have no effect, at least for some months, in reducing the liability to infection, as the intermediate hosts discharge infective agents for a prolonged period.

(4) Infected troops cannot reinfect themselves or spread the disease directly to others. They could only convey the disease to those parts of the world where a local mollusc could efficiently act as carrier.

(5) Infection actually takes place both by the mouth and through the skin. Recently contaminated moist earth or water is not infective.

(6) Infection in towns is acquired from unfiltered water which is still supplied, even in Cairo, in addition to filtered water, and is delivered by a separate system of pipes.

(7) Eradication can be effected without the co-operation of infected individuals by destroying the molluscan intermediaries.

(*To be continued.*)

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(*To be continued.*)

INJURIES OF THE SUPERIOR LONGITUDINAL SINUS.

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Symptoms of Injury of the Longitudinal Sinus.

Experiences in the present War have made us acquainted with many conditions which are rarely seen in civil practice and have especially presented to us groups of uncommon neurological symptoms or clinical pictures; these are also often less complicated and more sharply defined than those due to the ordinary pathological lesions, with which we were previously familiar.

The vascular lesions of the brain met with in civil life, for instance, are most commonly due to arterial disease, to thrombosis, hæmorrhage, or embolism, while primary affections of the cerebral veins are uncommon; on the other hand, in gunshot injuries of the head, especially when tangential or superficial, disturbance of the cerebral venous circulation by depression of fragments of the skull is frequent, owing to the superficial course of the cerebral veins and the fact that their thinner walls and the lower pressure of the blood that flows through them makes them more liable to be blocked by pressure than the arteries.

The most striking clinical effects are, however, produced when the cranial sinuses into which these cerebral veins flow are affected, and in our experience much the most common of these to be involved is the superior longitudinal sinus. This receives on either side the veins which drain the mesial aspect, as well as those which carry blood from the superior half of the lateral surface of each hemisphere; while the veins from the lower part of each lateral surface pass through the sylvian system which opens directly or through the sinus spheno-parietalis into the cavernous sinus. There is often, however, a fairly free anastomosis between these two sets of lateral cerebral veins, and consequently complete occlusion of the one set may not necessarily produce permanent blocking

of the venous outflow from the area naturally drained by it. A sudden blockage may, however, lead to circulatory disturbance sufficient to abolish, temporarily at least, the functions of a part of the area normally drained by the venous system affected.

The manner in which the superior cerebral veins open into the longitudinal sinus is important in relation to the symptoms produced by lesions in its neighbourhood. This arrangement has

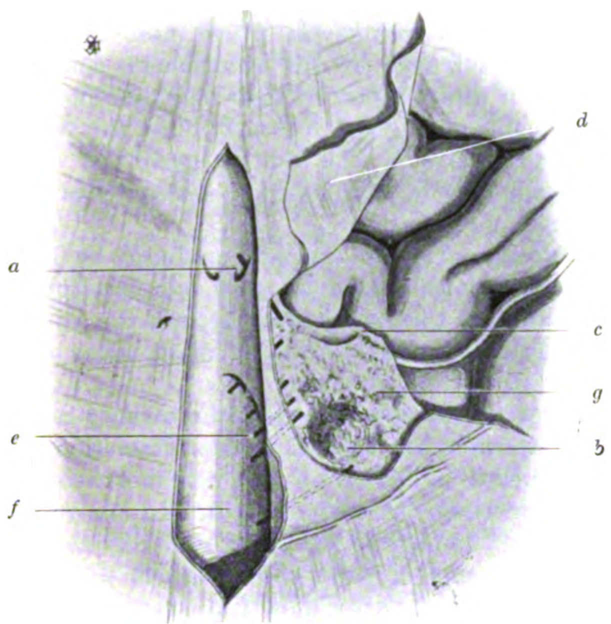

FIG. 1.—Dissection of the parietal lacuna on the right side, showing the opening of the post-central vein into the lacuna, and of the lacuna into the longitudinal sinus by six apertures. *a*, superior longitudinal sinus laid open by cutting away its roof; *b*, a lateral lacuna, laid open in a similar manner, showing a Pacchionian tuft projecting into its floor, and at *c* the valve-like opening of a large cortical vein; *d*, dura mater turned back to show the cerebral convolutions; *e*, glass rods showing the channels by which blood reaches the sinus from the lacuna; *f*, rod passed through a forwardly directed opening; *g*, a large Pacchionian tuft.

been fully described by one of us (P. S.). Although there is no strict constancy the superior lateral veins usually unite into four principal trunks, a frontal, a pre-central, a post-central, and an occipital; of these the post-central is usually the largest, and, as it drains the central gyri, the most important. As a rule these veins do not open directly into the sinus, but into thin-walled lacunæ

that project from it over the lateral as well as over the mesial surface of the hemisphere. A small frontal lacuna receives the frontal vein, a large parietal lacuna the pre- and post-central veins, and an occipital lacuna the occipital vein. Sometimes these lacunæ are more or less continuous. The larger veins either open directly into the floor of the lacuna, from which the blood finds its way into the sinus by several small openings, or they may pass beneath the lacuna and open directly into the longitudinal sinus generally supposed, and may spread at least two and a half centi- (fig. 1). The parietal lacunæ are often more extensive than is metres on to the convexity of the hemisphere, consequently any depressed bone or direct injury in their neighbourhood within this distance of the middle sagittal line may block the venous circulation of the upper parts of the central gyri, and owing to the thinness of walls this is more easily produced by pressure on the lacunæ than on the rigid sinus.

Different groups of symptoms are produced by lesions of the different lacunæ, but we intend to limit our description to those due to disturbance of the circulation through the parietal lacunæ, when they are predominantly those of disturbance of motion and sensation.

We have up to the present seen over seventy cases in which the longitudinal sinus was injured, or the circulation in its venous tributaries disturbed in its immediate neighbourhood, i.e., in the lateral lacunæ, or where the veins enter it. In many of these cases there was no direct damage to the brain, either by the projectile, or by depressed fragments of bone, but in others the disturbance of the venous circulation was associated with gross cerebral lesions.

The symptoms in these cases have naturally varied very much, according to the severity of the injury and the region in which the sinus was damaged, but the chief features of the condition can be best conveyed by describing a typical case; other types and other symptoms which occur will be considered later.

Case 1.—Private J. H. was wounded by a bullet on December 12, 1914. He became unconscious at once and was unable, on admission to the Base Hospital two days later, to give any accurate information about himself. He was dull and apathetic but answered questions quite readily.

There were two separate penetrating wounds four centimetres apart and equidistant from the midline, and about seventeen centimetres behind the nasion, that is, slightly behind the midpoint. The entrance was on the left; the exit on the right was slightly larger and slightly anterior to it; the skull between them was comminuted and some

disintegrated brain escaped through the exit. His speech and the functions of all his cranial nerves were unaffected, but the retinal veins were swollen and the inner margins of the optic discs were blurred and indistinct. His arms lay adducted to his side, flexed and pronated at the elbows, and were very rigid at the shoulders and elbows, but only slightly so at the wrist and in the fingers. He was unable to perform any voluntary movement with the right, but could flex and extend the left fingers feebly. The abdominal muscles were rigidly contracted and his respiration was mainly thoracic. Both lower limbs were very rigid and fully extended at hips, knees and ankles, and rotated inward and adducted at the hips so that the patellæ came in contact with one another; owing to their position and their extreme rigidity they resembled strongly the lower limbs of a severe case of Little's disease. This extensor rigidity was not constant, as occasionally the limbs were found rigid in flexion, but as a rule it was so great that the limbs could not be passively flexed or separated from one another by any reasonable force. The knee- and ankle-jerks were much exaggerated, and the hamstring-jerks were present and brisk; the flexor-jerks in the arms were also exaggerated but the triceps-jerks were feeble; both plantar responses were extensor and the abdominal reflexes were absent. When admitted his mental state was too dull to permit a proper examination of sensation.

Three days later he had a prolonged left-sided Jacksonian fit which commenced in the face. Ten days after receiving the wound he showed definite signs of improvement; his lower limbs were still completely paralysed and extremely rigid, fully extended, adducted and rotated inwards, but he was now able to move his fingers freely, and perform feeble movements at the elbows; the shoulders were, however, still rigid and their movements completely paralysed.

Twelve days later all movements of the upper limbs were possible, but the proximal muscles, especially of the right, were very feeble and all efforts he made were very ataxic; both arms were still rigid at the shoulders, and the right at the elbow, and constantly lay closely adducted to the sides and flexed. The legs, too, remained extremely rigid, extended, adducted and rotated inwards, but he occasionally had strong flexor spasms in them, especially when turned on his side. No definite voluntary movement of either was possible and any effort only resulted in a general contraction of all their muscles, and a slow, vigorous extension if any segment of the limbs were flexed. Stimulation of either sole produced a vigorous withdrawal movement of the limb without any contralateral effect. All the tendon-jerks were greatly exaggerated, the plantar responses were of the Babinski type and the abdominal reflexes were abolished.

The examination of sensation revealed, especially on the right side, the disturbances found in pure cortical lesions when the stage of shock or diaschisis has passed; the lightest touches could be appreciated

normally but a certain percentage of purely tactile contacts failed to evoke a response, and this failure bore no definite relation to the intensity of the stimulus. Localization of touch stimuli was, however, not seriously disturbed. There was no diminution to painful stimuli and no definite subjective difference in pin-pricks between normal and possibly affected parts. The appreciation of position and of passive movement was almost completely lost in both lower limbs and in the right arm, but was little affected in the left arm, and corresponding thereto the discrimination

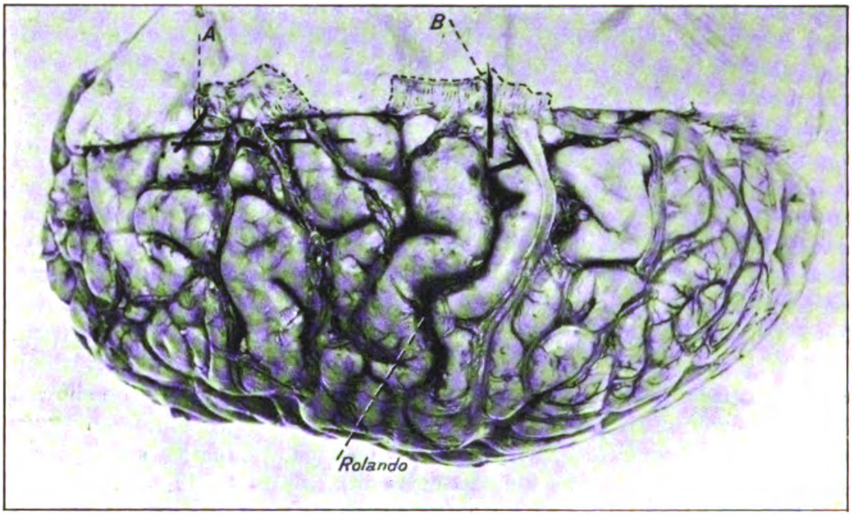

FIG. 2.—Photograph of the left side of a brain with the dura mater thrown back over to the right to show its inferior surface and the lateral surface of the left hemisphere. The frontal and parietal lacunæ are surrounded by broken lines; the entry of the larger cerebral veins into their under surfaces is clearly seen. Those entering the frontal lacuna as well as the smaller vein which passes from the precentral sulcus into the parietal lacuna are thrombosed, but the main post-central veins escape. The dura mater was not torn, but the sinus was compressed between the points *A* and *B* by a depressed fracture of the vault. For the sake of clearness the smaller veins which entered the sinus or lacunæ have not been preserved in this dissection, or in that from which fig. 3. is taken.

of Weber's compass points was much disturbed in the legs and in the right arm; the two points could be distinguished one centimetre apart on the left palm, while on the right they could not be recognized at double this distance, or on the soles when separated to ten centimetres.

During the time he remained in the Base Hospital he had slight difficulty in passing urine and occasionally incontinence; this he explained as due to the fact he could "only hold his water for five minutes or so," and that it then passed involuntarily if he did not receive a urinal. He was evacuated to England five weeks after receiving the wound and had

gradually improved during this time. His subsequent history is not at present known.

In other cases we have been able to keep the patients longer under observation and in some instances learn of their subsequent course. From our own observation we are of opinion that when the brain itself has not been at the same time damaged by the missile, the symptoms due to obstruction of the venous circulation diminish gradually, and will eventually disappear, almost or entirely, and this impression is borne out by the later histories we have received of patients transferred to England. The degree and rate of improvement may depend as much on the inconstant anatomical arrangement of the veins and the amount of anastomosis between the two lateral venous systems as on the severity of the lesion.

Such relatively rapid improvement in a severe case may be illustrated by:—

Case 2.—Lance-Corporal S. was wounded by a bullet at short range on December 21, 1914. He was unconscious for a short time and was afterwards unable to move either leg or his right arm. Speech was, however, unaffected, and he had only slight headache.

There was a sagittal gutter wound of the scalp six centimetres long, its anterior end slightly to the left of the midline and vertically above the tip of the mastoid and its posterior end on the midline, with fracture of the outer table, and probably depression of the inner table.

When he entered the Base Hospital two days after receiving the wound his face and tongue were unaffected, but the right arm was completely paralysed. The power of his left arm was unaffected but there was considerable sensory ataxia in its movements. The lower limbs were also powerless, and the right especially was rigid. All the deep reflexes were exaggerated, stimulation of the soles gave extensor responses and the abdominal reflexes were absent. The sense of position and the discrimination of compass points were lost in the right arm and in both lower limbs, but tactile and painful stimuli were normally appreciated everywhere.

He was occasionally incontinent, which he attributed to the fact that often he did not feel when he should pass urine.

Five days after the wound there was some return of power in the right fingers, wrist and elbow, but the movements he could execute were weak. His legs were still rigid and motionless. A week later all movements of the right arm were possible and those of the distal segments almost quite strong, but the limb was very ataxic owing to severe disturbance of sensation in it. His legs were less rigid and he was now able to flex and extend both hips, but no movement of the knees, ankles or toes was possible. The sense of position, the appreciation of passive

movement, the discrimination of compass points, and the localization of tactile stimuli were seriously disturbed in his right arm and in both lower limbs; but light touches, painful stimuli and vibration were normally appreciated. The recognition of form (stereognosis) was also defective, but not quite lost, in the right hand.

Five weeks after being wounded his right arm was slightly weak only at the shoulder, but was still ataxic, and he could now execute all movements at the hips and knees, but they were weaker than normal; the ankle and toe movements were still completely paralysed. The deep reflexes were still much exaggerated, and ankle clonus was present on both sides as well as the Babinski sign.

The rapid improvement of his symptoms continued till he was evacuated to England two months after being wounded. His right arm was then quite strong and all movements of both lower limbs were possible, though the distal segments were still slightly weaker than normal. His legs could now bear his weight, but he needed assistance in walking owing to the marked ataxia of these limbs, which was due to the sensory disturbances which, though less pronounced, were still considerable.

Before we discuss the symptoms in this large group of cases it will be advisable to consider the pathological changes to which they are due. We have been able to study these pathological lesions in a certain number of cases by post-mortem examination and have obtained microscopical preparations of the affected areas in a few, but the opportunity for a complete histological examination has not yet occurred.

We have already stated that in many of the cases in which the chief symptoms were due to injury of the longitudinal sinus or its tributary veins, associated lesions of the brain existed, and in describing the essential pathological changes it will obviously be necessary to separate such cases from those in which the venous system only has been directly damaged.

The most common type of injury is a gutter or tangential wound at the middle line of the head, which may be either sagittal, coronal or oblique. In many cases the skull, though exposed, showed no evidence of fracture of the outer table either to inspection or an X-ray examination, but the latter generally revealed a depression of the inner table at or near the middle line. In other patients both outer and inner tables were depressed and if the damaged bone was removed it was seen to present a spoon-shaped depression in the skull, the inner table being more depressed than would be expected from a superficial examination. Such depressions as a rule merely compressed the sinus or its lacunæ

and rarely injured their walls. Frequently however the injury was a perforating wound or an in-and-out wound of the skull, the entrance and exit being on opposite sides of the middle line and close to it, with considerable comminution of the bone between them ; here the sinus was generally lacerated and in certain instances it was completely cut through by the missile, but it was occasionally only compressed by in-driven fragments of bone.

On removing the skull-cap, or on operation when this was attempted, a thrombus was usually found in the longitudinal sinus, its character depending on the duration of the case, but as the sinus is divided up by irregular transverse trabeculæ, and held open by its rigid walls and the support it receives from the dura mater, it is probable that in many cases the thrombus did not occupy its whole lumen. When the injury lies to one side of the middle line the thrombosis may be limited to the lateral lacuna beneath it.

When the dura mater was removed the most striking feature was the condition of those superficial cortical veins which enter the sinus at the position of the wound ; these were swollen, firm to touch and could not be emptied by pressure, and there frequently seemed to be congestion of the neighbouring veins which were not actually thrombosed. The superior parts of the hemispheres which are drained by these veins were usually swollen and the convolutions flattened by pressure against the inner surface of the skull and generally firm to touch. On section there was obviously much œdema of the cortex and subcortical white matter and minute hæmorrhages, which were grouped more closely in the neighbourhood of the wound, were found. In a few instances there was an actual softening near the mesial fissure, the disintegrated brain matter being blood-stained and punctiform hæmorrhages were found in the cerebral tissue around it.

In a few of the cases which came to post-mortem examination and in others in which the condition could be observed during operation there were widespread subdural hæmorrhages which usually formed a thin layer of blood over the convexity, but sometimes extended to the base of the same hemisphere; in other cases cerebrospinal fluid removed by lumbar puncture was either blood-stained or straw-coloured. These superficial hæmorrhages undoubtedly produced some rise of intracranial pressure and contributed to the severe headache with which many of these patients suffered, but they seemed to play a subordinate part in the production of the other symptoms. Thin layers of hæmorrhage into the soft membranes and even sub-pial hæmorrhages are common.

Under the microscope the most striking change is the œdema of the affected areas, which is more prominent in the white than in the grey matter. Many of the superficial veins may be thrombosed and the rest are much congested. Minute hæmorrhages occur in both the grey and white matter, but chiefly in the proximity of the wound; many are mere perivascular extravasations. Occasionally slight perivascular round cell infiltrations are met with, especially in the neighbourhood of softenings. The walls of the latter consist of disintegrated tissue and large numbers of granule cells.

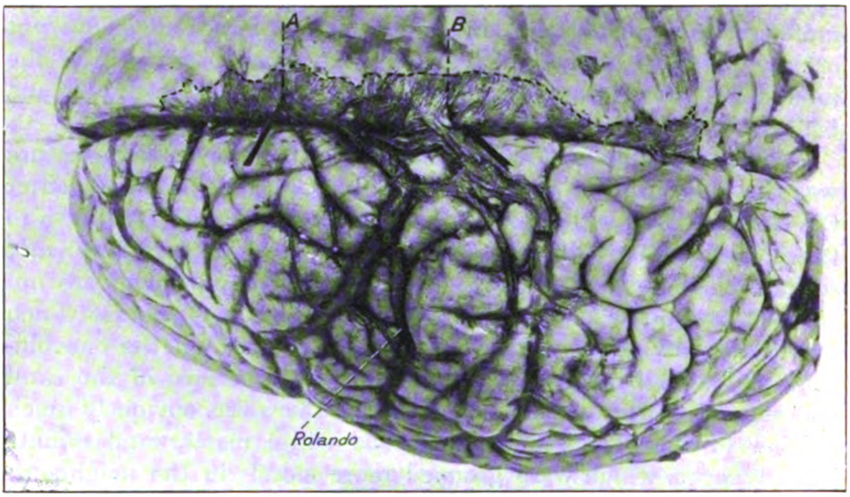

FIG. 3.—Photograph taken as in fig. 2. In this case the frontal and parietal lacunæ were not definitely separated and are both enclosed by a broken line. The longitudinal sinus and the lacunæ were compressed by a depressed fracture between *A* and *B*, and the veins which enter it at this region are completely thrombosed. The swollen, œdematous condition of the brain in the region of the thrombosed veins is obvious.

The nerve cells in the affected areas show pronounced changes; they are generally swollen and in advanced chromatolysis, the Nissl bodies having disappeared or being represented merely by irregular clumps at the periphery of the cell. Many cells, however, appear almost homogeneous and hyaline, and in relation to the age of the patient often contain an access of pigment when death did not occur soon after the infliction of the wound.

When we look at the clinical symptoms we are at first most struck by the unusual distribution and type of the motor paralysis.

The extent of the palsy naturally varies according to the site, severity and extent of the lesion; we at present have notes of 20 cases in which all limbs were affected; in 31 both legs and one arm were weak; in 16 only the lower limbs were affected; in 6 the symptoms were mainly hemiplegic, and in 5 one leg alone presented any palsy.

The distribution of the paralysis and its relative severity in different segments of the limbs is, however, peculiar, and differs from that of the cerebral palsies most commonly seen in civil practice. As in Case 1, when the upper limbs are affected the finger movements either escape or are weak for only a short time after the injury, and rapidly recover and regain their normal power. The hand movements have never remained long weak, except when the sinus condition has been complicated by an independent injury of the brain. The wrist movements, and especially those of the elbows, are affected more severely and recover less rapidly, while those of the shoulder often suffer when the more distal segments of the limbs escape, and recover much less quickly when the whole limb has been involved.

It is consequently the more proximal segments of the upper limbs which are most seriously paralysed, and the weakness diminishes distalwards. In this respect the paralysis contrasts strongly with that seen in the ordinary hemiplegia due to vascular lesions in which the distal segments of the upper limbs are almost invariably more severely affected than the proximal, and recover less rapidly. Further, a definite paresis of the face or tongue is extremely uncommon, and is at the most transient, and speech is never affected in the pure sinus injuries.

The distribution of the palsy in the legs is the converse of that of the arms; here it is always the distal movements that suffer more severely, and in slight cases and during the recovery of more severe ones we have repeatedly seen complete paralysis of the toes and ankle only, with the knee movements only relatively weak and those of the hips strong.

This distribution of the paralysis and its relative severity in the the different segments of the limbs obviously depends upon the arrangement of the cortical motor centres and on that of the cortical veins. The motor centres for the lower limbs are arranged from above downwards on the apex and lateral surface of the hemisphere in the following order—movements of the toes, ankle, knee, hip; then the small motor centres for the trunk movements intervene, and below them come in succession the motor centres

for the shoulder, elbow, wrist, and fingers. On the other hand, the superior cerebral veins which open into the longitudinal sinus drain the central gyri, as a rule, to just below the inferior genu of the fissure of Rolando, which corresponds approximately to the centre for the wrist movements, and if the area they drain be put out of function, a complete paralysis of the voluntary movements of the opposite lower limb, shoulder, and elbow, with weakness of the wrist movements, and little disturbance of those of the fingers might be expected.

The distribution of the lateral cerebral veins, and the amount and the freedom of the anastomosis between the superior and the inferior systems apparently varies greatly; and this will naturally influence the extent of the paralysis even though there be complete occlusion of the superior system; but if the lesion is slight and the occlusion is incomplete, the circulation through the smaller and more slender veins that drain the apex of the hemisphere and its mesial aspect would be more liable to become blocked than that of the larger and more thick-walled vessels; in this case only the motor centres for the more distal segments of the lower limb may suffer.

Further, while a mesial lesion is liable to produce bilateral symptoms, a one-sided paralysis of the same type may result from an injury to the one side of the middle line which blocks the circulation through a lateral lacuna, or in the veins as they enter the sinus.

When these symptoms which we attribute to venous lesions, and especially weakness of both the lower limbs, result from an injury of the vertex of the skull in the neighbourhood of the upper ends of the fissure of Rolando, they might be attributed to a direct damage or to compression of the motor centres, which lie under the wound. But in the first place the type of the paralysis, and especially the rigidity associated with it, is unlike that which occurs when other parts of the motor cortex are injured or compressed; and in the second, as in Case I, the paralysis is often too extensive in relation to the severity of the wound to permit the assumption of a direct injury. Thirdly, as the lateral parietal lacunæ overlie the more mesially situated motor centres, they must obviously be involved by any injury that would directly damage or compress them.

Even more striking than the unusual distribution of the paralysis is the rigidity which is almost always associated with it. It is generally co-extensive with the paralysis, and closely related

to it in its degree. Thus it is always most pronounced in the lower limbs, and when the upper are also involved it is greater at the shoulder than at the elbow, and is rarely present and never pronounced in the wrist or fingers.

The early onset of this rigidity is another striking point; we have seen it well marked within twenty-four hours of the infliction of the wound, and in some instances, at least, it has been noticed by the patient almost at once. It has shown no tendency to increase after the patients have reached the base hospitals, that is usually within forty-eight hours, but, on the other hand, it gradually

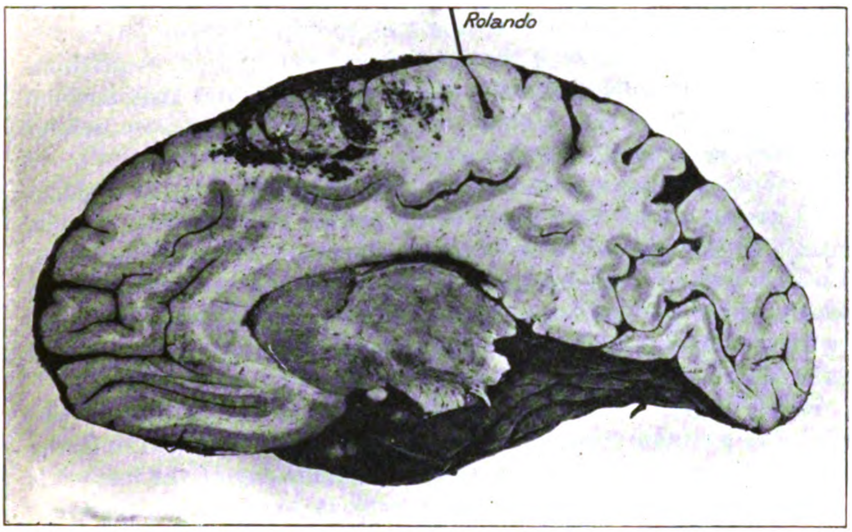

FIG. 4.—A sagittal section of a brain to show the multiple small hæmorrhages into the affected region, a subarachnoid hæmorrhage on its surface, and œdema of both grey and white matter extending backwards behind the fissure of Rolando.

diminishes *pari passu* with any return of power that may occur. The rigid limbs generally assume very characteristic attitudes; when the arms are affected, they lie closely adducted to the sides and rotated inwards, with the elbows flexed and pronated, and in severe cases the wrists and fingers in moderate flexion. Even the trunk muscles may be involved, and then the abdominal wall is unnaturally rigid and respiration is mainly thoracic; in a few cases, indeed, there has been slight difficulty in coughing, and phonation has been monotonous and toneless owing to the poor inspiratory intake. As a rule, the lower extremities lie fully extended at all

joints, firmly adducted and rotated inwards with the feet occasionally crossed; in fact the attitude is practically identical with that which is so characteristic of a severe cerebral diplegia. In certain cases, however, the knees are partially flexed, but they are always adducted, and rotated inwards.

The rigidity is often so great that the resistance to passive movement is extreme; it may, for instance, be quite impossible for a man of moderate strength to separate the knees. If passive movement is possible it is found that the rigidity involves all groups of muscles and is more or less equal whether the limb is passively flexed or extended. It is also continuous throughout the whole range of any passive movement that is made, and it has never shown any tendency to the "clasp-knife" type.

We have also observed that peripheral stimulation, as pricking the sole or palm, increases the rigidity, and the legs may become more rigid when the patient coughs or attempts any strong voluntary movement with his arms.

It is interesting and important that despite the great rigidity there seems to be very little tendency for contractures, that is, organic shortening of the muscles, to develop; in one severe case, of which, through the kindness of Dr. Head, we have heard eight months after the infliction of the wound, no contractures have occurred, although there was for a considerable time great rigidity of the legs.

Reflex spasms of the lower limbs have been associated with the rigidity in a certain number of cases; they have been of the flexor type, and in one case at least occurred from the day of the infliction of the wound. They may be so severe as to cause considerable discomfort to the patient, but gradually diminish in frequency and severity as improvement sets in. Reflex withdrawal of the legs can be easily evolved by peripheral stimulation, especially of the soles, but in only one case have we a definite record of an associated contralateral extension of the opposite limb.

In the rigid cases the tendon-jerks have been much exaggerated from the earliest moment at which they have come under observation; a striking feature as in ordinary hemiplegia and in cerebral palsies directly due to gun-shot injuries of the head, these reflexes are frequently absent for some time; but when the limbs are in rigid extension the extensor reflexes, i.e., the knee and ankle jerks —are much brisker than the hamstring jerks, while if in flexion the latter jerk has been the more exaggerated. Similarly in a case in which the elbows were rigid in flexion the flexor reflex, that is,

the biceps-jerk—was much increased, but the extensor reflex—the triceps-jerk—could not be obtained.

The great toes are usually permanently extended and a typical extensor response is usually obtained on stimulation of the soles, but in a few cases there has been a definite flexor response, although there was unquestionably motor paralysis of the distal segments of the lower limbs. Naturally this is also obtained in another type to which we shall later refer, in which the inability to move the limbs is due to sensory disturbance only.

Perhaps the most interesting physiological problem presented by a study of these cases is this extreme muscular hypertonus which appears very early after the injury and is closely related to the paralysis of voluntary movement. It is obviously impossible to enter here into the complex problem of the pathogenesis of rigidity, but it is now generally assumed that, as Hughlings Jackson originally taught, the increase of tone is due to removal of the inhibition which higher centres, and in this case the cerebral cortex, normally exert on the lower nervous mechanism which maintain tone in the muscles. In an ordinary hemiplegia due to a cortical or internal capsular lesion the affected limbs are, apart from some transient early rigidity, flaccid for a few weeks at least, and lose their tendon reflexes for a shorter period, and we have found the same condition in severe traumatic cerebral lesions. There must be consequently some essential difference in either the site or the nature of the pathological condition which produces paralysis in these cases, which we may group together under the title of "The Longitudinal Sinus Syndrome." It appears improbable that the level of the injury, that is the portion of the upper motor area involved, is the essential factor, as it is only the cell bodies and the upper portions of their axis cylinders which suffer with thrombosis of one of the cortical arteries, and we assume that that it is only the cell itself that is temporarily put out of function by a prolonged local epileptic attack, in both of which conditions the palsy is flaccid. This temporary flaccidity, which is later followed by an exaggeration of muscle tone, is attributed to the effect of shock which depresses, for a time, the activity of the lower centres that reflexly maintain tone.

If we look for any possible peculiarity in the nature of the cerebral lesion in these sinus cases, we are at once struck by the remarkable absence of evidence of such shock. This is especially seen on investigating the disturbances of sensation which they present; while in the early stage of an ordinary case of cortical hemiplegia

the sensory loss is partly due to functional disturbance produced by shock in the subcortical sensory mechanisms, in the cases we are considering here the sensory loss, even in the earliest stage, is almost invariably such as can be attributed wholly to a pure cortical lesion. It must be remembered too that the damage to the cortical cells associated with this sinus thrombosis is not complete or irrecoverable, the nature of the histological changes and the fact that a remarkable degree of recovery of function may occur is evidence of this, but it is improbable that the type of cell change produced by the œdema and ischæmia of the brain can be the explanation of this early persistent rigidity. On the other hand we are probably correct in assuming that the venous thrombosis produces a pure cortical paralysis unaccompanied by any shock effect on the subcortical centres which subserve muscle tone.

The sensory disturbances in these cases are especially interesting as they are almost always those of a pure cortical lesion unaccompanied by any shock effect. The appreciation of pain and temperature is unaffected and there is no definite diminution of tactile sensibility, but a certain number of light contacts are not recognized; there is, however, no threshold alteration and the proportion of those missed is not directly related to the intensity of the stimulus. On the other hand the localization of tactile stimuli, the recognition of the position and of passive movements of the limbs, as well as of form, shape and size, and the discrimination of the compass points may be seriously disturbed. The slightness of the affection of cutaneous sensibility has been frequently astonishing, as many patients have complained spontaneously of numbness or of having "no feeling" in their legs.

When the wound has been some distance behind the upper end of the fissures of Rolando, sensory symptoms have been the most prominent feature. One man, in whom there was a superficial coronal wound of the skull six centimetres behind the midpoint, had no demonstrable weakness of his legs or change in their reflexes, but he complained that both legs were numb and on examination profound loss of the sense of position and in the discrimination of compass points was found. Owing to this sensory loss he was unable to walk and on trying to do so only staggered and fell about the room; Romberg's sign was also well marked.

It is of course known that when the sense of position and the appreciation of movement are suddenly and completely abolished in a limb, aimless, involuntary movements of it may occur spontaneously. This was well illustrated by one case in

which an oblique tangential wound crossed the midline seven centimetres behind the midpoint. It is possible that the brain was directly damaged by indriven fragments of bone, but more probable that the symptoms were due to venous thrombosis.

There was no weakness or rigidity of his legs though both were very ataxic and the reflexes were normal, but in both there was pronounced sensory loss of the cortical type. When his legs were uncovered both were jerked about at irregular intervals in a curious aimless and irregular manner. Sometimes the one was raised from the bed and either thrown across or separated from the other; at other times it was quickly drawn up and extended again, or the foot was dorsiflexed or the toes moved about. The patient became conscious of the movements only when one leg touched the other or when it fell to the bed. In their impulsive aimless and incoordinate character these movements were very similar to those of chorea.

In a certain number of cases the functions of the bladder were affected. In the majority of these there was at first some difficulty in passing urine, or even retention necessitating the use of a catheter, in one case for as long as five days, but this symptom always disappeared rapidly. Less frequently incontinence occurred and in a few patients persisted for a considerable time; the bladder apparently emptied itself reflexly owing to deficient cerebral control when it had filled to a certain point, and some patients, as Case I., explained that they were able to hold their water for a few moments only after the desire to micturate had come.

As a rule the functions of the cranial nerves were unaffected, but in several patients the ocular movements were disturbed. In one group there was either temporary weakness or paralysis of the associated conjugate movements of the eyes without ptosis or affection of the pupils; one patient in whom all four limbs were affected was unable to move his eyes to order in any direction except slightly downwards, but he could follow, though not fully, a finger which was moved to either side or upwards. The visual axes always remained parallel. Within a fortnight however all movements had returned and only upward deviation was at all defective. There was a similar inability to perform all conjugate ocular movements in another patient in whom all four limbs, excepting the fingers, were paralysed and this persisted till his death on the fifth day after the infliction of the wound. More commonly, however, there was only weakness of the lateral conjugate movement of the eyes to one or both sides, or much effort was needed on the part of the patient to perform them.

We have not yet been able to make the histological examinations necessary to determine the cause of this palsy of the conjugate movements, but it seems probable that it is due to a temporary paralysis of the centres for ocular movements in the posterior part of the second frontal convolutions. We have occasionally observed a similar defect in local lesions of this region.

In other cases, eight in all, we found an isolated palsy of one or other oculomotor nerves, generally of the third, or of the third and fourth cranial nerves. This proportion is very striking when we consider the comparative rarity of ocular palsies in other types of gunshot wounds of the head; it seems probable therefore it is related to the lesion we are considering. On the other hand it might be due to a fracture of the base of the skull, to basal meningitis or hæmorrhage, or to the effect of the considerable rise of intracranial pressure which is so often present in these cases. In some cases, however, in which a post-mortem examination was made we could exclude basal lesions, and in only two of the eight cases was the sixth nerve affected, although it is of course known that this nerve is much the most liable to suffer from a pathological increase of intracranial pressure.

Fits were observed in ten of the patients; in two both sides of the body were involved, but they were limited to one side in the others. From the descriptions we received, as well as from our personal observations, the unilateral seizures apparently commenced in the face or hand when there was extensive palsy of the convulsed side, or in the lower limb when the paralysis was limited to its distal segments, that is the excitation started either in motor centres which were only partially damaged, or in their immediate proximity.

Other complications are relatively rare. Meningitis occurred in some in which the dura mater had been lacerated and the brain damaged directly; and in one a general pyæmia, from which, however, the patient recovered, developed secondary to a septic wound of the sinus. It is surprising that we have encountered only this one case of general infection, considering how commonly pyæmia occurs in connection with septic bone related to the lateral sinus. A secondary hemiplegia occurred in two cases, in one after an operation in which the longitudinal sinus bled freely and had been plugged with gauze, and in a second thirteen days after the infliction of the wound and ten days after an area of depressed bone compressing the sinus had been removed.

The general symptoms of intracranial pressure have been as a

rule pronounced. Most of the patients have suffered considerably from headache, and in some it has been particularly severe. In five cases there was also definite optic neuritis with considerable swelling of the discs, and not merely such congestion and blurring of their edges as is seen in a large proportion of all gunshot wounds of the head. In four of these cases at least, we could exclude meningitis and secondary cerebral abscess, and must consequently attribute the ophthalmoscopic change to the œdema and swelling of the brain.

The treatment of injuries of the longitudinal sinus presents considerable difficulties. When there is a defect in the skull to one side of the middle line and the brain is lacerated by indriven fragments of bone, the wound should be dealt with as if it lay in other regions of the head, but special care is necessary to avoid and control the serious hæmorrhage that is apt to occur from the sinus or its lacunæ.

If the symptoms are due, however, only to compression of the sinus or its lacunæ, the immediate removal of the compressing bone would at first sight appear to be the rational treatment; but experience has shown that the results of surgical interference have been extremely unsatisfactory. Among 39 cases we observed which were operated upon either by ourselves or others, 15 deaths occurred in the Base Hospitals, while only one among the 37 unoperated upon cases died before transference to England. These figures have not of course an absolute value as it was naturally the most serious cases which were on the whole selected for operation, and in 7 of the fatal ones there was in addition some direct injury of the brain. They are, however, sufficient to emphasize the danger of operation. On the other hand it must be remembered that the uncomplicated cases show a remarkable tendency to improve, probably owing to the free venous anastomosis permitting a re-establishment of the circulation.

If operation is necessary, it is advisable to remove bone all round the depressed portion and only then elevate this, for if hæmorrhage occurs the surgeon is then in a more favourable position to control it. As a rule some bleeding from either the sinus or its lacunæ occurs when the fragments of bone are removed, but it can generally be arrested by placing a piece of pericranial tissue or muscle on the laceration and keeping it in position for a short time by moderate pressure, and then carefully replacing the scalp flap over it. This method is certainly preferable to arresting the hæmorrhage by a gauze plug, as it is not so liable to produce

further thrombosis. When the sinus is completely divided or much lacerated a plug may be, however, necessary.

When there are serious symptoms of intracranial pressure a subtemporal decompression may be necessary; it was performed in a few of our patients. It is of course a safer operation than a large opening in the neighbourhood of the wound, as the latter exposes the patient to the risk of intracranial infection from the septic scalp. We have, however, found lumbar puncture, repeated frequently if necessary, sufficient to relieve the pressure symptoms in several cases.

As in one case a subdural clot was partly removed through a subtemporal decompression it might appear advisable to perform this operation if a meningeal hæmorrhage were suspected, but at the most only a small portion of a clot can be removed through a moderate craniectomy opening, and post-mortem experience has shown that there is usually only a thin layer of blood on the surface of the hemisphere, and that a considerable part of it spreads to the base of the brain when it is inaccessible to the surgeon.

REPORT ON FIFTY-EIGHT CASES OF ACUTE NEPHRITIS OCCURRING IN SOLDIERS OF THE EXPEDITIONARY FORCE, INVESTIGATED AT ST. BARTHOLOMEW'S HOSPITAL FOR THE MEDICAL RESEARCH COMMITTEE.

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Though in general the health of the Expeditionary Force has been so good, some anxiety has been occasioned by an outbreak of cases of acute nephritis. At the request of the Director-General the Medical Research Committee made arrangements for its immediate investigation and the Committee have defrayed the special expenses connected with it. Arrangements were made for a number of these cases to be placed under my care in wards at the St. Bartholomew's Hospital section of the 1st London (City of London) General Hospital. Dr. Mackenzie Wallis and Dr. Trevan have made the chemical investigations involved. Captain F. W. Andrewes, F.R.S., Professor of Pathology in the Hospital Medical School, has reported on the morbid anatomy of the kidney, and the pathological investigations have been carried out in the pathological department of the hospital of which he is the director. Dr. R. G. Canti has particularly interested himself in carrying out many of these. Mr. Foster Moore has reported on the condition of the eyes in the majority of the cases. Without the cordial co-operation of all these gentlemen this investigation could not have been attempted.

It has been thought advisable to issue this interim report for the information of those medical officers who are engaged in treating these cases of nephritis, before the whole investigation is complete. Observations confirmatory of, additional, or opposed to those herein described would be welcomed. In this way it is hoped that a useful contribution to the medical history of the War may be arrived at.

Incidence.

It appears that 1,062 cases of acute nephritis occurred in the Expeditionary Force up to the end of June. The monthly returns show that very few cases occurred till February, in which month 72 cases were reported, 138 in March, 220 in April, 211 in May and

326 in June. Of these cases 58 have been investigated at St. Bartholomew's Hospital. These figures differ strikingly from those of the South African War. The late Dr. Washbourn reported that "acute nephritis was singularly infrequent." At Deelfontein there were only six cases of acute Bright's disease in whom the disease was contracted in South Africa. Old standing nephritis with an acute attack superadded was more frequent. Moreover, there can be little doubt that the disease has been much more frequent in this campaign than in civil practice. As acute nephritis is not a notifiable disease it is impossible to provide exact figures, but it may be said that at St. Bartholomew's Hospital, where the number of medical cases admitted in a year averages 7,000, there were in a period of nine years only 166 cases, 120 males and 46 females. In a period of five years only 26 cases were admitted in men between the ages of twenty and forty, which is a better standard of comparison. Again, among the troops serving in the United Kingdom the incidence of nephritis closely approximates to the peace ratio for this disease. We may conclude that ordinarily acute nephritis is a rare disease in men of a military age and that a special explanation must be sought for the present frequency of the disease in the Expeditionary Force.

It was thought by some observers that the condition was commoner in the older soldiers, but the ages of the patients admitted to St. Bartholomew's Hospital do not bear this out. Arranged in hemidecades the age incidence was as follows :—

Under 20	2
20 to 24	14
25 to 29	11
30 to 34	13
35 to 39	10
40 to 44	5
45 or over	3

Etiology.

In dealing with a comparatively small proportion of the total number of cases it is of not much value to tabulate the places at which the disease was contracted; the cases came chiefly from

Ypres	15
Bethune	12
Boulogne	6
Givenchy	4
Festubert	3
Floubaix	3
Richebourg..	3

Exposure to wet and cold has always been held to play an important part in the causation of acute nephritis, but this epidemic goes far to disprove that contention. For during the winter when there was much wet weather the cases were few and far between, and it was not until the weather was better that the disease assumed epidemic proportions. In each case, however, careful inquiry was made into the question of recent exposure to wet; in twenty cases there was a definite history of this, but in thirty-eight cases no history could be obtained.

The water supply has also been suggested as a possible cause; whether by reason of its being obtained from an unwholesome source, or by chlorination or from metallic poison derived from the galvanized water-carts or the water-bottles. It may be said at once that these cases lend no support to any such hypothesis; the sources from which the patients had obtained water were extremely variable, as is shown by the following table:—

Source from which water was obtained	Wholly	Partially
Water carts	17 ..	7
Pumps	13 ..	13
Dug-outs	5 ..	7
Springs	1 ..	4
Ponds	1 ..	0
Wells	1 ..	3
Town water supply	1 ..	1

Moreover in some cases the patients had been careful about boiling the water, in others they had not; in some cases the water had been chlorinated, in others not.

Another suggestion was that the disease was rife amongst the horses. We need not stop to inquire whether they derived it from the same source as the men or whether it was transmitted by or to the horses, since investigation has failed to reveal the existence of the disease among the horses to any extent. Only ten of the patients had had the handling of horses; it is interesting that one of these volunteered the statement that his horses had strangury.

None of the men admitted for acute nephritis had been wounded, and no case of acute nephritis occurred among the wounded men admitted to St. Bartholomew's Hospital. Clearly, if the disease is due to an infection, a wound infection plays no part in it. As respiratory symptoms have been common in this series of cases, it should be mentioned that only two of the men had previously suffered from gas asphyxia.

Excessive protein diet has been suggested as a possible cause.

It seems highly improbable that one hundred and eighty grammes of protein would cause acute nephritis in a number of otherwise healthy men, and that without impairing the health of the others in any way. Moreover, as will appear later, the evidence is in favour of an infective rather than a merely toxic change in the kidneys, and, a more important point, there were no signs of an intestinal toxæmia.

On this point Dr. Mackenzie Wallis's observations appear quite definite. Proteins as such would not exert a toxic influence; they could only do so through their putrefactive products. Among the more striking of these products is indican, which can be readily recognized in the urine. But it is not altogether a safe guide to the total amount of putrefactive change. The putrefactive bodies are largely combined with sulphates and excreted as ethereal sulphates; indican is merely one of these. Normally the ethereal sulphates form about one-tenth of the total sulphates. With intestinal intoxication the ethereal sulphates rise both absolutely and relatively. In the cases investigated the total amount of ethereal sulphates was low, probably because of the relatively low protein intake, and the proportion of ethereal sulphates did not show an increase. Another guide to the amount of intestinal putrefaction is the presence of urobilin in the urine. Urobilin is derived from the bile pigment in the bowel by the reducing action of the bacteria there. In this series of cases urobilinuria was not observed. If fermentative rather than putrefactive changes predominate, oxalates are apt to be formed in considerable quantities and crystals of calcium oxalate are found in the urine. In this series calcium oxalate crystals were only found twice. So that the evidence is all against excess of either putrefactive or fermentative changes in the bowel.

Acidosis has been suggested as a cause, on account of the frequency with which dyspnœa occurred in the early stages of the disease. It is not clear how acidosis could arise on the diet given to the troops, nor is there a general agreement that acidosis can cause nephritis. The cases of dyspnœa investigated did not show acidosis as a constant feature.

In a few cases the disease was evidently an exacerbation of old trouble, there being a clear history of previous attacks in 5, 3 of them being apparently scarlatinal in origin. In 3 others there was a history of scarlet fever but no evidence of previous kidney trouble.

An ætiological factor of some interest was the high percentage

of positive Wassermann reactions. The reaction was done in 56 cases and was positive in 18, being strongly so in 4, and feebly so in 3. That is to say, practically one in three of the cases was positive, and though this is too low to make a specific taint the cause of the disease, it is high enough to make it a probable factor in lowering the patient's resistance. It is noteworthy that in three out of the four instances where the reaction was strongly positive there was evidence of extensive kidney damage, with a tendency to prolonged hæmaturia and to relapse. I gather that an incidence of nearly thirty-three per cent is higher than the incidence of syphilis in the Army in general. It may be added that the majority of the positive reactions were in the long service men, though three out of the four strongly positive reactions were in men who had enlisted for this war.

Pathology.

That the disease may be considered a form of nephritis is sufficiently shown by the combination of œdema with albuminous urine which also contains blood and casts. But a nephritis may be the result either of an infection or an intoxication. Taking scarlet fever as the classical example of an acute nephritis due to an infection it is generally admitted that the stress of the disease falls especially on the glomeruli, though the tubules are not spared. In a toxic nephritis, on the other hand, such as that produced by corrosive sublimate, the lesion is tubular. It seemed important to determine how far the glomeruli and the tubules were respectively involved in these cases, as the methods of combating an infection and a toxic agent would differ widely.

Certain tests are relied upon to differentiate the parts of the kidney chiefly affected, and I may summarize here the principal results obtained by Dr. Mackenzie Wallis and by Dr. Trevan, which will be published *in extenso* later.

(1) *The Chloride Test.*—That chlorides are often badly excreted in nephritis is well recognized. In 1911 Schlayer went further and attempted to differentiate between tubular and glomerular damage by the reaction of the kidney to ingested chlorides. A kidney that is healthy can get rid of five grammes of salt by merely increasing the concentration of the urine: but if the tubules are damaged it cannot excrete urine of the requisite concentration. If the glomeruli were intact they could come to the assistance of the damaged tubules by excreting more urine of a low concentration and thus

help in the excretion of the salt. It is claimed that in an early stage of glomerular damage there is an exaggerated response on their part producing excessive diuresis, so that more salt is excreted than was administered. But if the damage to the glomeruli is more profound they are unable to respond by increasing the output of water, which may even fall. A rise in the percentage of sodium chloride in the urine, with a fall in the total quantity of this substance excreted, would be evidence that the tubules could respond while the glomeruli could not. The absence of a rise in the percentage of sodium chloride or an inadequate rise would be evidence, on the other hand, that the tubules were damaged.

This line of investigation has been carried out by Dr. Trevan in twenty-three cases. As some of these were getting rid of previously retained chlorides, i.e., were recovering from a tubular lesion, it was necessary to continue observations on the chloride output on a diet of known chloride content for some days before administering the dose of five grammes of salt. The general conclusion reached was that all the cases investigated showed damage to both glomeruli and tubules. In twelve cases, i.e., just over fifty per cent, the glomerular damage was sufficiently severe to produce an actual fall in the quantity of water excreted after the dose of salt.

He confirmed the fact of salt retention in four cases by determining that the chlorides in the blood were higher than normal.

(2) *The Iodide Test.*—According to Schlayer iodide is excreted by the tubules. In eight cases Dr. Trevan estimated the time taken to excrete a dose of two grams of potassium iodide, and also the amount excreted in certain periods of time. A great reduction in the total amount excreted was shown in every case. The evidence as to tubular damage as given by the chloride and iodide tests agreed fairly well in these eight cases. The difficulty in excreting iodide was further evidenced by the intolerance to iodide shown in those cases where it was given therapeutically because of a strongly positive Wassermann reaction.

(3) *The Lactose Test.*—Lactose injected intravenously appears to be excreted by the glomeruli. In three cases where this test was tried, Dr. Trevan obtained marked evidence of extensive glomerular damage, as there was marked delay in excretion. As a rigor occurred after the injection in one case, and hæmaturia in this and one other case, the test was discontinued.

(4) *The Diastase Test.*—Of recent years the amount of diastase

present in the urine has been used in the diagnosis both of pancreatic disease and renal permeability. In the presence of the former the diastase output is greatly increased. Given the absence of this the amount of diastase should vary between 10 and 22·2 units. But if the renal permeability is diminished this amount may fall to 5 units or less, and perhaps to 0. A colloidal substance such as a ferment would probably be excreted by the tubules. Dr. Mackenzie Wallis, who has paid special attention to this test for the last two years, has estimated the urinary diastase in fifty of these cases, in many of them on more than one occasion. The results have been interesting and valuable. In no instance was the diastase output increased, as it often is in toxic processes. In thirty-one cases the diastase value was low, and eight had none at all in the urine. Nineteen cases showed a normal value. Speaking generally, this method agreed with the others in indicating the cases with definite tubular damage. Those with normal values were usually slight cases. But further, this method was of distinct prognostic value, for those cases with a normal value generally recovered quickly, while those with a low value ran a more protracted course and showed a tendency to relapse. As the cases improved the diastase value tended to rise. Again in some cases the low diastase value persisted after the albuminuria had ceased, showing that the kidney had not completely recovered. The test has an important bearing on the prognosis, and a case of acute nephritis cannot be said to have recovered completely until the diastase value has returned to normal.

The Nature of the Proteins Present in the Urine.

Though this does not enable us to distinguish between the glomerular and tubular damage its determination enables us to distinguish an actual inflammatory lesion of the kidney from a functional albuminuria and from the so-called "leaky" kidney, which is not the seat of an inflammatory lesion. Dr. Mackenzie Wallis's investigations on this point show that the ratio of albumin to globulin in these cases ranged from five to one to six to one, which accords with all previous observations upon inflammatory conditions of the kidney.

All these tests taken together point to a nephritis of a diffuse type usually thought to be infective in origin and bearing no relation to that caused by metallic poisons.

Morbid Anatomy.

Up to the present only one of the cases at St. Bartholomew's Hospital has proved fatal, and a full report on the kidneys is not yet forthcoming. It can be said, however, that they showed extensive glomerular with some tubular change. One case, under the care of Major Calvert, at the First London General Hospital, died, and Captain F. W. Andrewes has furnished a report on the post-mortem examination and the histological appearances of the kidney. He found that all the glomeruli showed some evidence of inflammation, but that some were affected more than others. There was extensive damage in the convoluted tubules. The interstitial tissue of the kidney was œdematous and infiltrated with lymphocytes and polymorphs. The change was apparently recent, for there was no fibrosis. No micro-organisms could be found in stained sections. He concluded that the appearances were those of a fairly recent subacute diffuse nephritis, and that there was nothing to suggest that the nephritis was of any distinct or unusual type.

There is therefore a substantial agreement between all the methods of investigation. The improbability of a simple toxic agent or an intestinal toxæmia has already been shown.

We must next consider the steps that have been taken to detect an infective agency.

(*a*) *Blood Cultures.*—These were made in three cases, in two because of serious symptoms of a possibly septicæmic nature, and in the other because it was admitted to the hospital in an early stage of the disease. In all cases the blood was sterile.

(*b*) *Cultures from the Urine.*—Catheter specimens were obtained in twenty-one cases and cultures made. In eighteen of these the urine proved to be sterile. In the remaining three, *Bacillus coli communis* grew, but in two of these only when one cubic centimetre of the urine was taken, while the remaining case was not a typical one being much more of the type of pyelitis, which came on during an attack of typhoid fever.

There is therefore no evidence of the nephritis having been set up by an ascending infection, or by a blood infection, the stress of which fell upon the kidney. This accords with Captain Andrewes's observations on the morbid anatomy of the kidney.

(*c*) *Throat Cultures.*—Seventeen of the cases complained of a sore throat as an early, if not the initial, symptom. In view of the generally accepted association between tonsillitis and nephritis (see Sir Wilmot Herringham's "Kidney Diesase") it seemed important

to investigate this point. Cultures were taken from all the throats where soreness was complained of, and in several in which no such complaint had been made. It was found in every instance that streptococci grew in abundance, and sometimes in practically pure culture. Pneumococci, diphtheroids and *Micrococcus catarrhalis* were also found in some cases. Before it could be concluded that the streptococci were responsible in any way it was necessary that control observations should be made, since streptococci are normal inhabitants of the throat. Dr. R. G. Canti therefore made cultures from the throats of ten soldiers with nephritis, ten wounded soldiers who had not got nephritis, and ten civilian patients suffering from various surgical diseases. His report shows that the throats of the soldiers were, as far as bacteriological examination went, in a healthier condition than the civilians, while the throats of the soldiers with and without nephritis were closely similar. He is engaged in estimating the streptococcal antibodies in the blood of some of these cases. This would afford evidence of a recent streptococcal infection. So fart here is no proof of the presence of any excess of these antibodies.

While this points away from a possible streptococcal origin, there remains the possibility of a filter-passing ultramicroscopic organism being the cause. The comparative frequency of sore throat as a symptom and the failure to find a bacterial cause for a disease which is almost certainly of infective origin make it very important that a filter-passer should be looked for. Animal experiments with this object in view are now in progress, but it is too early to speak of results yet. It has been suggested that the cases are due to a suppressed form of scarlet fever, which is also thought to be due to a filter-passer. It is interesting in this connexion to note that so far cases of nephritis have not occurred among the Indian troops, and the natives of India are said to enjoy comparative immunity from scarlet fever. It is also interesting, in view of the frequency of otitis media in scarlet fever to note this occurred in two cases just before the œdema. But as the ordinary incidence of nephritis in scarlet fever is ten to twenty per cent, this view would entail the conclusion that there had been ten to twenty thousand cases of scarlet fever had occurred among the troops up to the end of June. The general health of the troops has been so good as to make such a large number of suppressed cases unlikely. Moreover, even in "scarlatina *sine eruptione*" desquamation follows, and this has not been observed in these cases.

Signs and Symptoms.

In the majority of cases the first thing noticed was the œdema, which usually started in the face and legs, and was curiously localized in some cases. The swelling became generalized in most cases. In one case admitted on the second day of the disease the legs and scrotum were very œdematous, but the rest of the body escaped. Œdema was almost a constant feature, being present in 53 cases, and of the 5 in whom it did not occur 4 gave a history of previous nephritis. In every case it soon cleared up.

Pain in the back was common at the outset, and was sometimes the initial symptom. It was not so common as œdema, however, being experienced in 37 cases. "Biliousness," nausea, vomiting and abdominal pain were given as initial symptoms by 6 patients, while 2 first complained of pains all over. Cough, diarrhœa and headache were occasionally the initial symptoms. Two cases developed an aural discharge just before the onset of the nephritis, again pointing to a possible throat infection. As already stated, 17 patients complained of sore throat at the beginning.

One of the most striking points was the frequency with which shortness of breath occurred as an early symptom. It was present in 49 cases, and only absent in 9. Of these 9, 2 had no œdema, while the œdema was slight in 2 others. Œdema occurred without shortness of breath in 3 cases. As a rule this shortness of breath started at the same time as the œdema, but did not last so long, having ceased at the end of two or three days. Only 5 cases had any dyspnœa while in St. Bartholomew's Hospital. The alveolar CO_2 was determined in each of these by Dr. Trevan: in 3 it was normal, while in the remaining 2 it was reduced from the normal five per cent to about three per cent. Dyspnœa due to acidosis is always associated with this reduction of alveolar CO_2 and uræmic dyspnœa is of this type. In three of the cases it would therefore appear that the dyspnœa was not uræmic.

Dyspnœa is not regarded as a common feature of acute nephritis. It may occur from uræmia or cardiac failure, of course, but the majority of these patients were not so ill that either the kidney or the heart was failing, and none of them showed signs of cardiac dilatation. The close agreement between the onset of œdema and dyspnœa suggests that the outpouring of fluid into the lungs or pleural cavities may have been responsible for the shortness of breath. This is supported by the frequency with which a cough

and bronchitis also occurred. Some of the early cases showed well-marked respiratory distress after their journey from France.

A slight and irregular temperature was common in the earlier stages and was sometimes prolonged where recovery was slow. More or less severe headache was common and was sometimes persistent. Anæmia was present in a fair number of cases, especially in those with a positive Wassermann reaction.

The urine was noted by the patients to be altered in most cases, though 11 failed to observe any change, 18 noted that it was scanty, while 8 observed that it was increased in amount. One patient noted great variation in the amount he passed; 8 had increased frequency of micturition, 3 had strangury, and 2 had incontinence; 22 observed that the urine was dark or actually contained blood.

While in hospital the variations in the quantity of urine were often striking, as illustrated by the following five cases, in which the extreme limits are given :—

52	to	140	oz.
60	,,	160	,,
30	,,	125	,,
35	,,	108	,,
42	,,	128	,,

The amount of urine was definitely reduced in fourteen cases; in these the output varied between eleven and thirty-seven ounces. But such extreme reductions as are usually seen in acute nephritis were not observed, and most of the above soon excreted larger quantities, while in some the amount was always increased. The highest figures observed were :—

100 to 120 oz. in	.. ..	8 cases
120 ,, 140 ,,	.. ..	5 ,,
140 ,, 160 ,,	.. ..	2 ,,

This variability in amount with frequently marked increase is due to what Muller called hyposthenuria; the kidney being unable to excrete a concentrated urine. Herrick says that it occurs not only in chronic interstitial nephritis, but also in acuter forms, especially when there is glomerular involvement. It was certainly a more marked feature of these cases than in the acute nephritis met with in civil practice.

The amount of albumin differed greatly. Usually it varied from a trace to 0·3 per cent as estimated by Esbach's method, but higher readings, such as 0·5 to 0·8 per cent were obtained occasionally. Some were estimated by the more exact Aufrecht method and yielded readings ranging from 0·001 to 0·3 per cent.

Red blood corpuscles were found in forty-four of the fifty-eight cases. The amount was very variable. Sometimes the urine was bright red with blood, sometimes merely smoky, and often chemical and microscopical tests were needed to detect the blood. A common feature was the settlement of a flocculent reddish-brown precipitate in which alone the blood could be found.

The reaction with tincture of guaiacum and ozonic ether was not found to be a reliable test for the presence of blood.

White blood corpuscles were present in thirty-six cases; sometimes only a few were found, but usually they were more abundant than is the rule in acute nephritis. Isolated renal cells, transitional epithelial cells, squamous cells from the lower urinary tract and cells from the genital tract were commonly found also in the centrifugalized deposit.

Casts were found in all but three cases. By far the commonest thing was to find a mixture of epithelial, granular and hyaline casts. Blood casts and fatty casts, on the other hand, were uncommon. The frequency with which the different forms were found may be tabulated thus :—

Blood casts	2
Epithelial casts	36
Fatty casts	7
Granular casts	51
Hyaline casts	33

Crystals were rare in the urine; calcium oxalate crystals were found twice, and uric acid crystals once. The rarity of organisms in catheter specimens has already been referred to. *Bacillus coli* was found in only three cases; in only one were they abundant, and this case also had pyelitis after enteric fever.

The systolic-blood pressure was estimated in every case, and usually on several occasions. The figures obtained were not very helpful; perhaps at the outset the pressure would have been found to be raised in all cases; it was one hundred and fifty-five in the case admitted on the second day of his disease. The figures obtained as soon as the patient had settled down after his journey may be tabulated thus :—

Blood-pressures	Cases
Under 120	4
120 to 129	13
130 to 139	10
140 to 149	10
150 to 159	9
160 to 169	6
170 to 179	3
180 and over	3

It may be said in general that as the patient improved, the pressure tended to fall to normal. The cases with a history of former attacks gave readings of 130, 148, 152, 155, and 200 respectively, but in a few days the 130 had fallen to 110, and the 200 to 140.

It cannot be said that the blood-pressure had a definite prognostic value. Thus three men were admitted with a pressure of one hundred and twenty-eight. The first had reached the eleventh day of his illness; eight weeks later there were still red corpuscles in his urine. The second was at the seventh day of his disease; ten weeks later he still had hæmaturia. The third had been ill a month, and he died eight weeks after admission. On the other hand, cases admitted with blood-pressures of 165, 168, and 179 have proved obstinate. Probably the best thing is a moderately raised pressure at the outset, falling fairly quickly to normal. Such cases have usually made a good recovery.

The eyes were examined by Mr. Foster Moore in fifty cases. He found—

No changes	37
Retinal hæmorrhages	4
Old iritis	1
Corneal nebula	1
Subconjunctival hæmorrhages	2
Conjunctivitis	1
Choroiditis	2

Of these changes only the retinal hæmorrhages were definitely associated with the nephritis, though the subconjunctival hæmorrhages were probably due to high pressure.

Three patients had fits which were presumably uræmic in origin. One of these had been venesected for fits in Boulogne. The other had a severe fit after reaching England and bit his tongue very badly. He had another epileptiform fit in the ward; yet he had never had fits before or after these two. His Wassermann reaction was negative, and he made a good recovery.[1] These were the only complications observed.

It may be added that the milkiness of the blood serum referred to by Bright in his original account of the disease was not observed in any of the fifty-six cases in which the blood was drawn for

[1] Since writing this, one new case had violent uræmic fits immediately after admission. They quickly yielded to free venesection.

Wassermann's reaction, but was present in the fatal case under Major Calvert's care.

Course and Prognosis.

On the whole it may be said that the disease has run a favourable course. Only one of the fifty-eight cases has died, and in no other case has life appeared to be in danger. It may also be assumed that the cases sent home have been the more protracted ones. The patient who developed the disease immediately after his return from France on leave, and who was admitted to the hospital on the second day of the disease, was free from albuminuria on the fourth day. Most of the cases have felt quite well as soon as the œdema subsided, though some have complained of headache, cough and digestive disturbances for a week or more. Yet many of those who felt and looked quite well were still passing albumin, blood and casts. A curious feature has been the tendency to relapse, in that there has been a return of albuminuria and hæmaturia, generally without ascertainable cause, though in some cases the first motor drive might be held responsible. The fact that they had been permitted to go for a drive shows that they were considered to be convalescent at the time.

Up to the present (August 5), twenty-two have apparently recovered. A considerable number of the remainder are still under treatment. Final statistics are not yet forthcoming, but the following data may prove of interest.

Blood was never found in fourteen cases. It disappeared from the urine in

10 days in	1 case
3 weeks in	2 cases
4 ,, ...	3 ,,
5 ,, ...	2 ,,
8 ,, ...	3 ,,
9 ,, ...	2 ,,

It was still present at the end of

6 weeks in	2 cases
8 ,, ...	4 ,,
9 ,, ...	2 ,,
10 ,, ...	2 ,,
12 ,, ...	3 ,,
14 ,, ...	1 ,,
20 ,, ...	1 ,,

Albumin disappeared from the urine in

4 days in	.. .. ..	1 case
10 ,,	.. .. ..	1 ,,
2 weeks in	.. .. ..	1 ,,
3 ,,	.. .. ..	4 cases
4 ,,	.. .. ..	3 ,,
5 ,,	.. .. ..	3 ,,
6 ,,	.. .. ..	1 ,,
7 ,,	.. .. ..	1 ,,
8 ,,	.. .. ..	3 ,,
9 ,,	.. .. ..	2 ,,
10 ,,	.. .. ..	1 ,,
14 ,,	.. .. ..	1 ,,

It was still present at the end of

6 weeks in	.. .. ..	4 cases
7 ,,	.. .. ..	4 ,,
8 ,,	.. .. ..	7 ,,
9 ,,	.. .. ..	4 ,,
10 ,,	.. .. ..	2 ,,
11 ,,	.. .. ..	1 ,,
12 ,,	.. .. ..	5 ,,
14 ,,	.. .. ..	1 ,,
15 ,,	.. .. ..	1 fatal case
20 ,,	.. .. ..	1 case

Casts have been observed to disappear from the urine at the end of

4 weeks in	.. .. ..	2 cases
5 ,,	.. .. ..	2 ,,
12 ,,	.. .. ..	1 ,,
16 ,,	.. .. ..	1 ,,

It has generally been observed in this series of cases, that as improvement occurred the units of diastase present in the urine rose to a normal level. Comparing the diastase reaction with the time of disappearance of the casts, it may be noted that in one case where the casts went in four weeks the diastase reaction was normal, that in another where they went within the same time, the diastase rose to normal as the casts disappeared. Where the casts disappeared in five weeks the diastase steadily rose to normal. On the other hand, where three months elapsed before the casts disappeared the diastase remained very low, and where four months were needed for the casts to go the diastase remained low until about the time this happened. But casts vanished in five weeks in one case where diastase was entirely absent, and it is interesting to note that this man still felt ill; he was one that had a strongly positive Wassermann reaction. In several instances there seemed to be no agreement between a normal diastase reaction and the

cessation of hæmaturia, but in general it may be said that a normal diastase reaction is of distinctly favourable prognosis, especially in the absence of hæmaturia.

All these dates have been calculated from the onset of symptoms and not from admission to St. Bartholomew's Hospital.

The fatal case suffered throughout from much anorexia, repeated vomiting and irregular temperature. Blood cultures were made on two occasions as a secondary infection was suspected; no growth was obtained, however. He developed more bronchitis, and a doubtful pericardial friction was heard on two days. He gradually became weaker, and passed less urine (on one day only eight ounces) and died at the end of fifteen weeks from the onset of symptoms. He never had any fits; the blood-pressure was only 128, and the Wassermann reaction was positive. Unfortunately, no post-mortem examination was allowed beyond the removal of the kidneys, which will be reported on later.

Treatment.

There is unfortunately not very much to be said under this head. Speaking generally, the cases were kept in bed as long as there was any hæmaturia or even marked albuminuria. Otherwise, unless there were some special symptoms the patients were allowed up, and when convalescent went into the square. The hospital milk diet was given in the first instance. This consists of:—

Tea	1 pint
Bread	14 oz.
Milk pudding	8 ,,
Milk	2 pints
Butter	1 oz.

This diet contains approximately:—

Proteins	86 grm.
Fats	77 ,,
Carbohydrates	353 ,,
Calories	2550 ,,

As improvement occurred, the next step was to add two eggs to the diet, giving it an approximate value of:—

Proteins	100 grm.
Fats..	90 ,,
Carbohydrates	353 ,,
Calories	2,720 ,,

Cases which did not seem to do well on this were put on a special "Low Nitrogen Diet," on the view that in acute nephritis

a period of comparative nitrogen starvation would afford the most rest to the kidney. This diet was only given for a short time, though occasionally as long as a week if it was well tolerated. It consisted of:—

Bread	.. .. ..	6 oz.
Butter	.. .. ..	1½ ,,
Potatoes	.. .. ..	10 ,,
Greens	.. .. ..	4 ,,
Salad	.. .. ..	3½ ,,
Boiled rice	.. .. ..	8 ,,
Milk	.. .. ..	½ pint
Stewed fruit and sugar.		

This has a value of:—

Protein	.. .. ..	54 grm.
Fats..	.. .. ..	50 ,,
Carbohydrates	.. ..	290 ,,
Calories	.. .. ..	1,615 ,,

The chief deficiency in this diet is the lack of fat. In some cases it was improved by the addition of some cream cheese or salad oil with the lettuce. Its advantage was that while reducing the protein intake to about Chittenden's standard, it gave the men a greater variety. The rice was sometimes cooked with a tomato flavouring, which was appreciated. It could easily have been improved by the addition of jam, but the men having had jam constantly in their rations, did not like this. Exceptionally it was improved by the addition of honey, and but for the difficulty of cooking for a number of men, the fat could have been increased by frying the potatoes in fat or mashing them with butter. In this way a diet can be constructed which permits of variety while giving the kidney little work to do. Unless a considerable amount of fat is taken, however, the diet is of low calorie value, and is not suitable for prolonged use. Another drawback is that it requires a fair amount of salt to make it palatable.

It is difficult in a disease of such variable duration to assess the value of any treatment, but my impression is that this low nitrogen diet was a distinct benefit in several cases.

Where salt retention seemed to be a prominent feature, saltless bread and butter were given. While the salt excretion was being determined, a diet of known salt content was given, with saltless bread and butter, and a known weight of salt (one or two grammes, usually the latter) was added.

Drugs.—Potassium citrate was given where the excretion of urine was scanty or painful. Stimulating diuretics were never

given except theocin in some test cases. Theocin sodium acetate belongs, of course, to the caffeine group, but is claimed to have the power of increasing the permeability of the kidney. It occasionally seems to be of definite benefit in chronic nephritis. It was tried in three of these cases. In the first case it had a marked diuretic effect, and also raised the diastase content of the urine from 0 to 20. In the other two cases it had no effect on the diastase, and only a slight diuretic action. One of these cases also had a return of hæmaturia when the theocin was given. Theocin, therefore, like caffeine, diuretin, and theobromine, has an irritant effect as well as a diuretic action. It is an unsuitable drug as long as there is any degree of acuteness of the disease; in the more chronic stages, however, it does definitely increase the permeability of the kidney. When the drug is stopped, the permeability of the kidney returns to its former level. The dose administered was two grains twice a day.

Bicarbonate of soda was given in drachm doses where there was shortness of breath, and with definite benefit when the dyspnœa was accompanied by a low alveolar CO_2.

Potassium iodide was given where the Wassermann was strongly positive, but it was not well borne, and generally had to be discontinued. In one case its administration was followed by marked œdema of the eyelids, which soon subsided when the drug was discontinued. This is, perhaps, to be expected, considering the evidence given in Dr. Trevan's report as to the difficulty with which iodide was excreted by these patients.

Several drugs were tried for the relief of hæmaturia. Emetine having been tried with some success for various forms of bleeding, such as hæmoptysis, was given a trial in several cases, but without benefit. Liquid extract of ergot was tried in a large number of cases in twenty-minim doses three times a day. It generally diminished the amount of blood for a time, but it did not appear to be responsible for bringing the hæmaturia to an end. Tincture of hamamelis was also tried, but did not seem to give as good results as ergot. As already pointed out, the duration of the hæmaturia was so variable that attempts to estimate the value of a drug in its treatment are beset with fallacies.

CONCLUSIONS.

(1) These cases are true examples of acute nephritis, as shown by (*a*) the combination of œdema with albuminous urine containing casts; (*b*) the tests for renal permeability; (*c*) the nature of the proteins in the urine; (*d*) post-mortem evidence.

(2) The cases have been too prevalent to be merely accidental, and the close similarity of the symptoms suggest a common cause.

(3) Exposure, water supply, metallic poisons, and intestinal toxæmia can be excluded as the cause. The prolonged cases showed a high percentage of positive Wassermann reactions.

(4) The curve of incidence suggests an infective agent as the cause; this is supported by the degree of affection of the glomeruli, as shown by the chemical tests and the post-mortem evidence.

(6) Bacteria can apparently be excluded as the infective agent, but a filter-passing ultra-microscopic organism cannot be excluded. The point of entrance of the infection is possibly the tonsils.

(7) The outstanding clinical features of the epidemic are: (*a*) the frequency with which shortness of breath occurred at the beginning, which was not always associated with acidosis; (*b*) the great variability in the duration; (*c*) the tendency to remission and relapse; (*d*) the ultimately favourable prognosis.

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THE CAUSATION AND PREVENTION OF ENTERIC FEVER IN MILITARY SERVICE, WITH SPECIAL REFERENCE TO THE IMPORTANCE OF THE CARRIER.

BEING AN ACCOUNT OF WORK DONE AT NAINI TAL ENTERIC DEPOT, 1908-11.

By MAJOR D. HARVEY.[1]
Royal Army Medical Corps.

(*Continued from p. 508, vol. xxiv*).

PREVENTION.

IT follows, then, that if the cause of enteric fever and paratyphoid fever is the presence of infected persons in a snsceptible community the prevention of those fevers will lie in the detection and removal of such individuals.

To detect an unknown carrier, especially among a large number of inoculated men, is an exceedingly difficult task. If he should give rise to a few fresh cases his detection may be facilitated, but it is far better to go to the fountain head, and by the early detection and isolation of all enteric fever cases remove the carrier, or, at any rate, prevent his return to ordinary duty.

The writer is firmly convinced that in military service at least all carriers have previously suffered from an attack of enteric fever. It follows, then, that by the rapid and accurate diagnosis (by blood culture, Widal reaction and clinical picture) of all cases of fever, and the isolation and examination of all convalescents, it will be possible to eliminate carriers. Those who were carriers previously will automatically disappear as they become time-expired.

Such a condition of affairs now prevails in India, where we have a "carrier-free" Army.

To relate how this has been accomplished is the purpose of the remainder of this essay.

However, no paper dealing with the prevention of enteric fever in military service would be complete without a reference to antityphoid inoculation. The writer is well aware that but for the reduction of enteric fever brought about by inoculation it would have been impossible to deal adequately with convalescents; the

[1] Now Lieutenant-Colonel.

depots would at their inception have been overwhelmed by numbers.

Typhoid inoculation was first introduced into the Army in 1898, just prior to the outbreak of the South African War, by Professor (now Sir Almroth) Wright. He based the principles of his method on that of Haffkine for cholera. The vaccine consisted of a broth culture of typhoid bacilli of ten days' growth, killed by heating to 60° C. for half an hour. This temperature was regulated by Dr. Wright's ingenious paraffin thermometer, which indicated when a temperature of 60° C. had been attained, but, unfortunately, placed no check on its going much higher subsequently, as indeed it did frequently in the personal experience of the writer. At the time this was not thought to be a vital point and was regarded as being useful to "mac siccar."

The use of this vaccine was not attended with the happiest results, as the local and general reactions it produced were severe and the protection not always of a very high degree, although statistics collected from units during the South African War undoubtedly showed that there was a certain amount of protection, and also that if infection followed it was as a rule more mild in the inoculated than in the uninoculated.

Further investigations were conducted by Lieutenant-Colonel (now Sir William) Leishman and Major W. S. Harrison, R.A.M.C. Their object was two-fold:—

(1) To reduce the severity of the reaction.

(2) To increase the protection afforded.

The results of these investigations, which entailed a great deal of most elaborate and careful scientific work, were as follows:—

(1) A vaccine heated to 60° C., or over, for half an hour, is practically inert.[1]

(2) A vaccine which has been kept for more than three months is comparatively useless.

(3) A vaccine heated to 60° C., or more, gives rise to a much more severe local and general reaction than one heated to 53° C. for one hour.

(4) The minimum of reaction with the maximum of protection is obtained by the use of a vaccine which has been prepared from a forty-eight hours' growth in broth of an avirulent strain killed by heating to 53° C. for one hour, and 0·3 per cent lysol added to the cool vaccine.

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[1] This applies only to a broth vaccine of the *B. typhosus*.

With this vaccine as now in general use such excellent results have been obtained that little difficulty is experienced in getting volunteers. Typhoid inoculation was revived in India in 1904, when Captain Smallman, R.A.M.C., who was attached to the 1st Battalion Royal Fusiliers, arrived in the country with this regiment.

The regiment had prior to embarkation furnished the material for a series of critical experiments to discover the amount of the antitropic substances present in the blood serum after inoculation. Unfortunately, as regards the trial of the vaccine, this regiment was for the first two years in India placed in a station where the men were not exposed to the risks of typhoid infection and, subsequently, when they were moved to a station where enteric was endemic cases occurred as often among the inoculated as among the uninoculated; the fact being that the protection afforded by the original vaccine, then in use, had already vanished. For these reasons the experiment proved abortive and, indeed, in some degree the results retarded the cause of enteric inoculation in India.

A second regiment, the 17th Lancers, was a year or so later sent direct from England to Meerut, a station which, especially from the cavalry lines, had yielded many cases of enteric fever annually. One hundred and twenty-seven men of this regiment had been inoculated twice and twenty-three men once only, while four hundred and forty-three had not been inoculated. The vaccine used was Wright's as modified by the more recent investigations referred to. Sixty-three cases of enteric fever occurred in the regiment within a few months of their arrival; all but two were among the uninoculated. The two cases among the inoculated had only received one dose of vaccine. Not one of those who had been twice inoculated suffered from enteric fever, although all were exposed to the same risks.

This brilliant result, as recorded by Captain Luxmoore, R.A.M.C., the officer on special duty with the regiment, may be said to have re-established anti-typhoid inoculation in the Army, and the measure was thereafter actively pushed. Fortunately, the Commander-in-Chief showed himself to be interested, and a believer in the efficacy of vaccination, and in consequence it was at last well received by the regimental authorities.

At the same time a word of praise must be given to the medical officers who carried out the actual propagandism and inoculation, no light labour, and in the early days (1906) — I speak from personal experience—often a very thankless task.

Some figures are given showing the numbers inoculated during the last five years in India, and are taken from a paper by Colonel Firth published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for June, 1911 :—

	Inoculated	Ratio per 1,000
1906	4,682	66
1910	58,481	823

These figures speak for themselves, and when it is remembered that among the twenty per cent or so not inoculated are included those who have already passed through an attack of enteric fever, and also those men who are beyond the age of maximum susceptibility, we see at once what a remarkable change has been effected. In place of a susceptible community we have an immunized Army. This immunity can be shown directly by the results of the Widal reaction, and also by statistical returns.

AGGLUTINATION TABLES.

73 men tested.

51, i.e.	70	per cent	= ± 100.
14 ,,	19	,,	= ± 40.
8 ,,	11	,,	= Nil.

60 men tested.

35, i.e.	58	per cent	= ± 100.
19 ,,	32	,,	= ± 40.
6 ,,	10	,,	= *Nil.*

Of these, the majority had been inoculated within twelve months; ten of those who gave a negative reaction had been inoculated more than a year previously.

Of the 335 cases of enteric fever which occurred in 1910, 187 were inoculated men, and 148 were not inoculated. Incidentally, this shows, as everyone is aware, that inoculation is not an absolute protection; but it must be borne in mind that a number of these cases among the inoculated were really paratyphoid fever.

	Admission ratio	Death ratio
Inoculated	3·19	0·37
Uninoculated	12·72	2·06

Of the hundred and eighty-seven men who suffered from enteric fever during 1910 :—

25	per cent	had been	inoculated	one year.
46	,,	,,	,,	two years.
17	,,	,,	,,	three years.
9	,,	,,	,,	four years.
3	,,	,,	,,	more than four years.

Colonel Firth also attributes to inoculation the fact that there is now a definite postponement of the maximum incidence of

enteric fever from the first twelve months of Indian service, as previously, to the second or third year as at present.

The new arrivals are either freshly innoculated or are inoculated soon after landing. The protection lasts two years, but is wearing off gradually during that period. Moral: re-inoculate after thirty months.

TABLE SHOWING THE REDUCTION OF ENTERIC FEVER INCIDENCE SINCE THE INTRODUCTION ON A LARGE SCALE OF ANTI-TYPHOID INOCULATION[1] AND THE ESTABLISHMENT[2] OF THE DEPOTS FOR CONVALESCENTS.

	Ratio per 1,000	
Year	Admissions	Deaths
[1] 1906	15·6	3·19
1907	13·1	2·77
[2] 1908	14·6	2·74
1909	8·9	1·58
1910	4·1	0·62
	Actuals.	
1898	2,375	657
1906	1,095	224
1907	910	192
1908	998	191
1909	616	112
1910	335	47

Naini Tal Depot, 1911.

Of 18 enteric fever cases diagnosed by blood cultures	9 were inoculated, i.e. 50 per cent.
Of 39 ,, ,, diagnosed clinically	20 were inoculated, i.e. 50 per cent.
Of 85 paratyphoid fever cases	80 were inoculated, i.e. 94 per cent.

Ten years ago there were more deaths from enteric fever than there were cases in 1910.

A brief account of the history of anti-typhoid inoculation and of its firm establishment has been given, as, although latterly the work of the writer has lain along other lines, yet he is convinced that the reduction of enteric fever in India is in the main due to this practice. And he is also convinced that although inoculation is a "confession of weakness," yet it must always be one of the first weapons to be used when troops are about to be exposed to danger of infection over which we have no control, as when they are engaged on active service in a country where enteric fever is endemic among the inhabitants.

In some quarters, and these high quarters, the reduction of enteric fever incidence in military service has been attributed in

great part, if not entirely, to improved sanitary methods. Undoubtedly there has been of late years a great improvement in the personal hygiene of the individual soldier; this must have had a considerable bearing on the typhoid problem in reducing the opportunities of the carrier. But the writer is convinced that if a carrier was introduced into a station no amount of sanitary effort, as at present understood, would prevent the occurrence of fresh cases of enteric fever, although, of course, cleanliness, public and private, would reduce his opportunities.

It must be remembered that in India at least, apart from the substitution of a "wet method" of conservancy in place of the old dry-earth system, there has been no radical sanitary change of recent years. The latrines and cook-houses and barracks are the same buildings which were in use twenty years ago. It is, I think, a little unfair to our predecessors to say that there has been an enormous improvement in sanitation of recent years in India; and a perusal of an article, which is included among "Echoes from the Past" in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS of February 1912, will show that officers twenty years ago were just as keen and had also realized the importance of attention to sanitary details.

The difference now is that this keenness and knowledge are not confined to the Medical Corps only, but are shared and appreciated at their true value by the regimental officers who are the executives.

Roberts, in his book on "Enteric Fever in India," points out that sanitary effort has been effective against other "filth" diseases, but that, in spite of all efforts, and they have been very real and energetic since 1890, there has been a gradual and continued rise in the incidence of enteric fever since that time and up to the present (1906), if that incidence is calculated on the numbers of susceptible people exposed.

In his opinion, the only sanitary measure which could have any effect on the incidence of enteric fever would be the introduction of a water-carriage system of sewage disposal, and apart from this "all sanitary effort is mere beating of the air."

In spite of the fact that no water-carriage system of sewage disposal has been introduced, enteric fever has almost disappeared in India in the five years since 1906, when the above opinion was expressed.

It is obvious, then, that we must look beyond ordinary sanitary measures if we wish to discover the reason for this remarkable reduction.

TABLE.—ACTUAL NUMBER OF DEATHS AND RATES PER MILLE, 1862-1900, INDIA.*
Deaths and Death-rates only.

Periods. Average strength	Cholera	Enteric fever	Other fevers	Dysentery, diarrhœa	Total deaths, all causes
1862-70	2,630	1,589	1,441	1,700	13,020
59,827	4·9	2·9	2·6	3·15	24·2
		Total, 10·4 per 1,000.			
1871-80	1,592	1,184	724	946	10,363
56,213	2·8	2·1	1·28	1·7	18·67
		Total, 7·9 per mille.			
1881-90	899	2,342	431	546	8,744
61,399	1·46	3·81	0·7	0·89	14·24
		Total, 6·9 per mille.			
1891-1900	726	4,404	506	638	6,274
68,224	1·06	6·46	0·74	0·94	—
		Total, 9·2 per mille.			

* Table taken from "Enteric Fever in India," by E. Roberts.

In 1862-70 the death-rate from cholera was double that from enteric fever, that is, in the pre-sanitary era. In 1891-1900, a period of marked sanitary effort, the death-rate from enteric fever was three times as great as in 1862-70, and six times greater than that for cholera.

To everyone who had studied the question of enteric fever in military service in recent years it was obvious that although improvement in the water supply, etc., had almost eliminated cholera from the list of diseases to which troops were liable, it had had no effect whatever on the incidence of enteric fever. It was obvious, then, that some other cause or causes must be looked for to account for the increasing prevalence of the disease.

The work of Robert Koch and his fellow-scientists in Germany, which has already been referred to, at once directed attention to "man the storehouse of the virus."

The Government of India decided that an inquiry should be instituted on the lines of the German Commission, to determine whether enteric fever was due to the presence of infected persons among the troops. This inquiry was started in 1906, and the writer was fortunate enough to be selected as a member.

Major E. D. W. Greig, I.M.S., who was at the time in England, was directed to proceed to Germany to study the methods employed there at first hand. He made a stay of some months in the country and was given every opportunity to study the work in all its details. On his return to India work on similar lines was at once commenced.

I think there can be no two opinions as to the value of this work, although at the same time I am not prepared, as some officers are, to attribute the reduction of enteric incidence entirely to its effects and that of the depots subsequently established. At the same time no paper dealing with the prevention of enteric fever in military service would be complete which did not deal fully with these researches.

The work was commenced at Meerut in 1906. This station was selected as it had returned a large number of cases of enteric fever for several years. Colonel D. Semple, Director of the Central Research Institute, who shared in all the work of the inquiry, decided to commence by the examination of the excreta of healthy men in units in which enteric fever was endemic, with a view to the discovery of carriers. Out of five hundred men examined one man was found to be excreting the *B. typhosus* in his fæces.

On looking back on this work in the light of recent research, I am of opinion that we were lucky to find even one such case.

It was obvious that this line of work was not likely to prove productive, and as time was limited it was decided to abandon this side of the question and to take up the examination of actual cases of enteric fever, and to follow them up throughout convalescence. This was done in a series of eighty-six cases.

The urine and fæces of these men were examined daily. As three large nine-inch plates of Conradi medium were used for the fæces, and two for each sample of urine, it can be understood that to examine the excreta of a dozen or more convalescents was no light work. Each plate required approximately thirty cubic centimetres of medium, and every likely colony was picked off and investigated.

Of these eighty-six men, ten were found to be passing the bacillus in their fæces or urine for periods longer than six months after defervescence. This gives a percentage of 11·6, a very high percentage indeed; but, as a matter of fact, only two of these men ever became true chronic carriers.

In addition to this work on the fæces and urine which had such a practical bearing on the enteric problem in India, a considerable amount of work was done on the treatment of enteric fever cases by autogenous vaccines (Semple, *Lancet*, 1909). Also in all cases the Widal reactions, opsonic index and bactericidal content of the serum were estimated, with the view of discovering whether such examinations would be of use in the detection of carriers among convalescents and healthy men. The methods of estimating the opsonic index used by the writer in 1907 were as follows:-

Two volumes of serum diluted one-fifth, heated to 60° C. for ten minutes.

Two volumes of washed blood cells.

One volume emulsion of *B. typhosus*.

The whole mixed and incubated for fifteen minutes at 37° C.

An improvised incubator capable of holding eight tubes was utilized and was placed on the work bench.

The sera of a very large number of normal men were examined by this method, and it was found that none gave a higher count than an average of one bacillus per cell. The normal, therefore, was taken as unity, and the index of the patients' serum was recorded as the average number of bacilli ingested per cell. As a rule the patients' serum gave an average of five to ten or fifteen per cell, according to the stage of their illness, the highest point being reached about the third week of the fever. In one case which on admission gave a count of about ten bacilli per cell, the index dropped gradually from day to day and was entirely negative on the day of death, which took place from toxæmia about a week after admission to hospital.

An alternate method used by the writer at this time (1907) was to treat opsonic estimations on the same principles as agglutination tests, by means of dilutions; the highest dilution which reduced immune serum to the level of the normal being taken as the end point. This method was abandoned, as it was too laborious and occupied too much time.

The results so far as the detection of carriers was concerned were not satisfactory, as many convalescents who were not carriers showed raised indices and several carriers gave less than the normal counts.

One curious phenomenon noted was that the serum of one worker, who was being used as a "normal man," quite suddenly began to give a raised index to typhoid, and continued to rise till the count was equal to that of a severe case of enteric fever in the third week, i.e., an average of about twenty bacilli per cell. The blood and excreta of this man were carefully examined, but with negative results, and he was apparently in his usual good health.

Later on the writer was using his own serum as normal when suddenly the index commenced to rise and rose gradually for about a week, and then gradually subsided again to the normal. It would be well to keep such contingencies in mind, as otherwise they may give rise to error.

The serum of another worker, on the contrary, remained at unity for months without any variation.

The bactericidal content of the serum was also estimated by the usual method of utilizing a diluted broth culture of typhoid against varying dilutions of the sera. This method occasionally gave concordant results, but sometimes the normal gave a higher reading than the immune serum, this being due to a lack of free complement in the latter. This difficulty was overcome by heating both sera and adding equal quantities of fresh guinea-pig serum to the normal and to the immune.

The result of the work at the Central Research Institute and elsewhere was to direct attention to the fact that young soldiers, after an attack of enteric fever, may continue to excrete the bacillus in their fæces or urine for months, and in rare cases for years. When this fact was realized it was at once evident that the system in vogue at the time, of returning men to duty as soon as they were physically fit, was one attended with a considerable degree of risk. At least ten per cent of such men would be infective for varying periods.

It was therefore decided, as it would not be feasible to keep all men in hospital until such time as they might be considered non-infective, to establish depots in the Hills, to which all men convalescent from enteric fever should be sent, and where they would remain as long as they were found to be infective, and for at least three months if all examinations were negative.

It was thus proposed to meet two requirements :—

(1) To secure a place where convalescents from enteric fever would have an opportunity under favourable climatic conditions of recruiting their strength, and where they might gradually return to full duty by a series of carefully graduated exercises and drills.

(2) To establish a central laboratory where the excreta of these men could be bacteriologically examined, with a view to the detection of carriers and the quick return of the non-infective to duty consistent with their physical fitness. At the same time to continue the work begun at Kasauli on the duration of infectivity, and the identification of bacilli, etc.

The place selected for the first depot was at Naini Tal, in the Kumaon Hills. These barracks had been used for many years in the summer time for the reception of sickly men from the 7th and 8th Divisions. Convalescents from enteric fever had been accommodated in one block, and convalescents from malaria, etc., in the others, while healthy men on furlough were placed in tents.

It was now proposed to reserve the entire barrack-room accommodation (124) for enteric fever convalescents alone, from the 1st,

2nd, 3rd, 7th, 8th, and part of the 5th Divisions—that is to say from practically the whole of Northern India, from Nowshera in the north to Calcutta in the east, and as far south as Jubbulpore. Latterly men were also received from the 4th Quetta Division.

Unfortunately, when selecting these barracks for this purpose the local civil authorities were not consulted—Naini Tal is the summer headquarters of the United Provinces Government—with the result that there was continual friction and misunderstanding with the local authorities. One very highly placed civil medical man was of the opinion that *all* the men sent up to the depot were "carriers" and that all were excreting "millions of bacilli," and advised the Governor, Sir John Hewitt, in these terms.

An outbreak of enteric fever in the civil community was attributed to the depot, although none of the men were permitted to enter the town, which was distant one mile and a half from the depot and some hundred feet above it.

The depot was supplied by the same piped water supply as the town, and one medical man gravely considered the possibility of typhoid germs being placed in the water at the depot end of the pipe and travelling up against a strong head of water to the source of the distribution. One lady, the wife of a Surgeon-General, A.M.S., now retired, was heard to say that her "dear Naini would be quite spoiled," as she could no longer take a favourite walk for "fear of meeting one of these dreadful carriers."

It will be understood that the work of the depot, at no time of the most congenial, was not rendered any the more pleasant by reason of the local prejudice, which would never have arisen had the purpose and scope of the work been explained before its inception. But it is pleasant to be able to relate that the depot survived several "inquiries," and in 1910 it was visited by the Sanitary Commissioner with the Government of India, the late Lieutenant-Colonel Leslie, I.M.S., who came in the first instance at the request of the local government to condemn, but remained to praise, in that he not only exonerated the depot from all blame, but asked that he might be supplied with a detailed account of the plan of work, with a view to the institution of similar depots on the civil side.

No structural alterations were made in the barracks or latrines, but a boiler for excreta was provided and a steam sterilizer (Thresh-Delépine) was also sent up.

Saponified cresol was used in the latrines and, after boiling, the excreta were trenched on the hillside about half a mile below the barracks.

The men began to arrive at the depot on April 8, 1908, and have been passing up and down in constant but ever lessening numbers up to the present.

There was fortunately a very good and fairly well equipped laboratory situated near the Station Hospital, and about a mile from the depot. This laboratory was used in the hot weather by the Sanitary Officer of the 8th Lucknow Division, Major J. C. Morgan, R.A.M.C. No grant was given for the laboratory work of the depot, but it was stated in the preamble that material would be supplied by the Sanitary Officer, 8th Division, from his grant of thirty rupees *per mensem*. It may be said here that the bacteriological work could neither have been commenced nor carried on had it not been for the very cordial co-operation of the Sanitary Officer and his successor, Major J. C. Weir, R.A.M.C., who not only gave up practically the whole of their grant for this work, but also expended a considerable amount in excess, which they, only after a great deal of trouble, were able to recover from the financial authorities.

Lieutenant-Colonel D. Semple, Director of the Research Institute, Kasauli, who was interested in the carrying on of the work, contributed from time to time grants of material, without which it would not have been possible to do work on any scale at all, and indeed even with this assistance the work, as will be seen later, was sadly in arrear by the end of 1908.

With regard to the administration of the depot, it must be noted that the men were discharged from hospital before they left their stations and were provided with uniforms by their own units. They did not rejoin their regiments, but proceeded direct from hospital to the train and came straight up to the depot without passing through the civil station of Naini Tal. The original rule was that no man should be discharged from hospital until he had been free from fever for six weeks, and only if he was considered fit to travel and to eat ordinary rations on arrival at the depot. In some instances men who had never been on solid food and had only just got out of bed for the first time were sent up to the depot, although in many cases the railway journey occupied two or three days, followed by a *tonga*, or pony ride, of fourteen miles.

If possible, several men were sent from one station at the same time, and they were invariably accompanied by a non-commissioned officer.

Strict rules were laid down as to the necessity of care in regard to the disposal of the excreta of these men and all had received a course of urotropine.

The depot was run on a military footing, the staff consisting of a commandant, a medical officer, an adjutant, one subaltern (company officer), a quartermaster-sergeant, and an assistant surgeon. Discipline in the depot was carried out by the non-commissioned officers among the convalescents. There were as a rule a good supply of sergeants, as they have a way of avoiding inoculation and acquiring enteric fever. At one time, out of one hundred and twenty men in the depot, twenty-five were non-commissioned officers. All duties in the depot, such as guards, etc., were carried out by the convalescents themselves, and including the assistant surgeon who was quartered in the depot every man there was an enteric convalescent.

Latterly (1910) owing to lack of convalescents some difficulty was experienced in carrying on the duties.

The men usually arrived at the depot in the afternoon and were seen the following morning by the medical officer, and as a rule were excused duty for ten days or, if considered fit, might be allowed to do light duty. In some cases it was found necessary to admit the men to hospital for a few days. At the same time a capsule of blood and a blood film were taken from each man and the agglutination reaction estimated. For a time also a sample of urine from each man was examined, but owing to lack of proper equipment and the increase in the numbers of men this had to be given up. But latterly (1910) it has been possible to examine the urine and fæces of each man for a week after arrival.

The fresh arrivals were seen daily for ten days by the medical officer, and if considered fit were at the end of that period put on to light duty for another ten days, and then were allowed to do full duty.

The duties at the depot consisted of a carefully graduated scale of drills, including light marches, short parades, route marches, musketry, signalling, physical exercises, etc. Hockey and football were also allowed for those who were considered fit.

The result of this system was that at the end of a stay of three months or so, the men as a rule were fit and well and ready to take their places again in the ranks of their regiments, instead of, as in the case of men returning direct from hospital, requiring to be retaught their drills. The rapid improvement in physique of nearly all of the men was most gratifying, and apart from carriers no man was invalided home on account of ill-health, and only one death occurred in three years.

Several men with "enteric leg" were returned to their stations

after being in the depot for some months (twelve in one case) *in statu quo*, although they were able to carry out light duties all the time—one was a most efficient billiard-marker.

The method of collecting samples of urine and fæces for examination was as follows: ten, fifteen, or twenty men, as the case might be, were told off by the orderly serjeant to attend at the inspection room at 5 p.m. and again at 7 a.m. the next morning. These attendances were looked upon as parades and non-attendance as a crime and punished as such by the officer commanding depot. At 5 p.m. each man was given a small lidded tin, provided with a spoon, and was instructed to collect and bring to the hospital on the following morning a sample of his fæces. These tins were collected by the orderly on duty and packed for conveyance to the laboratory. At the same time (morning) each man passed a sample of his urine into a sterile bottle, which was also labelled and packed and carried at once to the laboratory. Here sufficient plates had already been poured to deal with the number of samples expected.

Conradi's original blue medium was used, and about two litres were used daily. A small portion (about one gramme) of the fæces was emulsified in five cubic centimetres of tap-water, and the mixture allowed to stand for about one hour; then two or three drops of the supernatant fluid were placed on a plate and spread with a glass spreader, which was again used to inoculate a second plate. The remainder of the emulsion with the glass tubes and rods and tins were placed in a basin of cyllin and the whole boiled for ten minutes. The urine was plated by placing one or two drops on a plate and allowing them to run over the surface. It was found that by getting the men to pass the urine directly into the sterile bottles and plating within a couple of hours or so, sterile plates were invariably obtained unless the man happened to be a carrier.

The same batch of men paraded for five days in one week, and again for five days in the next week, ten examinations in all. If the results of these examinations were negative the man was allowed to return to his station, provided he was otherwise fit and had been more than three months in the depot.

It is not contended that every carrier could be detected by this method, but as all the men before examination had been four or five months free from fever, it was regarded as the best that could be done under the circumstances. Later on, with more adequate equipment, it was possible to examine each man for a week after arrival and again for a fortnight before his return to his station.

Two known intermittent fæcal carriers were examined by the

two weeks method, and both were detected as passing *B. typhosus*, one twice during the ten examinations and one once.

Men who ultimately become chronic carriers are almost invariably *constant* carriers in the early months, although they may become intermittent later on. Thus the weekly examination on arrival was a great help in indicating the men who ought to be followed up carefully. At the same time, it must be admitted that in one instance a man was examined for a week on arrival and all examinations were negative, yet *B. paratyphosus* A was recovered from his fæces on several occasions two months later.

The majority of the men did not like to be kept in the depot, and it was a common thing to have men attending the sick parade in the morning, and on being asked what was the matter, saying, "Beg pardon, sir, might I be put on tubes?" meaning, could they be examined so that they might return to their stations. All the men were under the impression that they were infected—"germy" as they called it—on arrival and that it was not till they had been examined for some time that the germs disappeared. This idea was encouraged, as it ensured that each man was careful to bring a sample of his own fæces.

Known carriers were required to pass their excreta in hospital, and any suspected carrier had a sample taken from his excreta by the orderly in addition to the sample supplied by himself.

During the three years, 1908-11, no case of deliberate substitution was encountered.

The method of examination of the plates prepared from fæces or urine was to pick off all non-lactose-fermenting colonies, i.e., all blue colonies. Many of these proved on further investigation to be capable of splitting lactose. Small drops of high titre serum diluted 1 in 60 were placed on a glass slide, and a small portion of the colony to be tested was rubbed up in the drop.

The sera used were for typhoid, paratyphoid A and paratyphoid B. Great difficulty was experienced in obtaining serum for A, as the Berne Institute does not stock it; but some was obtained from Kasauli, and an animal (rabbit) was immunized at Naini Tal, although several were killed in the process. Apparently, susceptibility is increased rather than diminished by repeated doses of this bacillus, and any attempt at increasing the dose may be followed by a complete disappearance of antitropic bodies, and possibly the death of the animal.

Whether the colony was agglutinated (macroscopically) or not by the typhoid serum, it was invariably also tested in A and B

serum, and a colony which was immediately agglutinated by one serum and made an even grey emulsion in the other two, was always regarded hopefully.

A curious fact is that the majority of freshly isolated paratyphoid A bacilli are agglutinated in the typhoid serum as well as by their homologous serum, although the converse is not the case. If the colony was found to agglutinate in any one serum, in two, or in all three, it was planted out on an agar slope for further investigation. On the following day it was retested from the agar culture in the sera, and a series of "sugar" tubes was inoculated.

The following were used as routine measure:—

Maltose.
Lactose.
Glucose.
Mannite.
Peptone water.
Milk (litmus).
Cane-sugar.
Neutral red agar (glucose), shake culture.

These were examined daily for a week and the results recorded from day to day. If a tube was found to be fermented a plate culture was made to show whether this was due to a possible contamination.

A second agar culture was made and agglutination tests were carried out from this.

(1) With the serum of the man from whose excreta the bacillus had been isolated.

(2) With the serum of a carrier or of a man whose agglutination titre for typhoid was known.

(3) With the specific sera.

All these estimations were made in sedimentation tubes with emulsions made in saline solution and standardized by counting or opacity.

Absorption tests were used in all cases where there was any doubt, and latterly in every case.

These latter tests have shown that there are bacilli to be met with in human fæces which will apparently give all the reactions of a true typhoid bacillus and are agglutinated by human serum, and yet "are not what they seem." At the same time, the writer has met with bacilli which obviously did not belong to the typhoid group (fermentation of cane-sugar) and yet absorption with a strong emulsion of these bacilli removed all the agglutinins from the specific serum (paratyphoid B).

I do not think, indeed I may say after an experience of some years, I know, that it is not sufficiently realized how closely the bacilli of the typhoid group may be simulated by other bacilli in human excreta. These bacilli are not commonly met with, any more than bacilli of the typhoid group are commonly met with, but they do occur every now and then and give rise to mistakes.

Quite a number of men were sent up to the depot as "carriers," yet in no single instance did these men prove to be true carriers, although in the excreta of several of them bacilli closely simulating typhoid or paratyphoid bacilli were met with. As a rule, these bacilli were agglutinated by one or other of the specific sera, but differed from the typhoid group in their sugar reactions. In one instance a man was invalided home by the writer as a carrier, although on looking back I am quite convinced that he was never a true carrier, but was excreting one of these readily agglutinable bacilli resembling typhoid. Mention is made of this case under "Notes on Carriers."

Some examples of bacilli which simulated bacilli of the typhoid group are given below.

It is somewhat difficult to describe on paper the reactions of these various strains of bacilli, as some apparently gave the true sugar reactions of the typhoid group, and were also agglutinated by one or other of the specific sera, and could only be condemned from the quantitative point of view, as it were. Others, when the results are put on paper, are apparently far removed from the typhoid group, and yet it was only after prolonged work that these could be excluded.

Reactions of bacilli isolated on the same day from the fæces of Private H. and Private N.

Clear blue colonies; clump at once in A serum, not in typhoid.

Sugar Reactions.

Peptone Water Tubes.

	24 hours	48 hours	One week
Lactose	*Nil*	*Nil*	*Nil.*
Glucose	,,	Acid	Acid.
Mannite	,,	,,	,,
Cane-sugar	,,	*Nil*	*Nil.*
Milk	,,	,,	Acid.
Peptone	,,	,,	No indol.

Agglutination Reactions.

Serum of Private H., an enteric convalescent.

	Dilutions 10	20	40	100	200
H.'s bacillus	+	+	+	+	+
N.'s bacillus	+	+	+	+	+
Paratyphoid A	–	–	..	..	..

Private N.'s serum. Enteric convalescent.

	Dilutions 10	20	40	100
H.'s bacillus	+	+	+	+
N.'s bacillus	+	+	+	+
Paratyphoid A	−	−	..	..

Private B.'s serum. Paratyphoid convalescent.

	Dilutions 10	20	40	100
N.'s bacillus	+	+	+	+
H.'s bacillus	+	+	+	+
Paratyphoid A	+	±	−	−
Typhoid	+	+	±	∓

Private B.'s serum after absorption with N.'s bacillus.

	Dilutions 10	20	40	100
N.'s bacillus	−	−	−	−
H.'s bacillus	+	+	+	+
Paratyphoid A	+	±	−	..
Typhoid	+	+	±	+

Private B.'s serum after absorption with H.'s bacillus.

	Dilutions 10	20	40	100
N.'s bacillus	+	+	+	+
H.'s bacillus	−	−	−	−
Paratyphoid A	+	±	−	..
Typhoid	+	+	±	∓

These were interesting bacilli, as it was found that they were immediately agglutinated by every sample of human serum they were tested against and yet were not agglutinated in a control tube of saline solution. Absorption with one bacillus only removed the homologous agglutinin, showing that this was specific, and although both bacilli were agglutinated by paratyphoid A serum they could not remove the agglutinins for this bacillus from the serum of a convalescent. Had it not been possible to use specific sera of high titre these bacilli would have resembled typhoid bacilli very closely as they were agglutinated by the sera of convalescents.

Colony isolated from the fæces of Private W.

Agglutinated at once macroscopically by A serum, not by typhoid or B.

Sugar Reactions.

	24 hours	Ten days
Lactose	*Nil*	*Nil.*
Mannite	A + G ¾*	A + G.
Glucose	A + G. Total*	A + G.
Cane-sugar	*Nil*	*Nil.*
Milk	Acid	Acid.
Peptone	..	No indol.

* Too much gas for paratyphoid A.

Did not remove the agglutinins from paratyphoid A serum by absorption.

Colony isolated from the fæces of Private G.

Agglutinated at once in A serum, not in typhoid or B.

Sugar Reactions.

Lactose	*Nil.*
Glucose	A + G ¾.
Mannite	A + G. Total.
Cane-sugar	*Nil.*
Milk	Acid.
Peptone	*Nil.*

The colonies of this bacillus on a Conradi plate, where they had room to grow out, were too large and coarse for the typhoid group, but the smaller colonies were apparently quite typical.

Absorption Tests.

Untreated high titre serum specific for A bacillus.

Stock paratyphoid A	Immediate clumping.
K.'s bacillus	,, ,,
W.'s bacillus	,, ,,
G.'s bacillus	,, ,,

Serum A after absorption with W.'s bacillus.

Stock paratyphoid A	Immediate clumping.
K.'s bacillus	,, ,,
W.'s bacillus	No clumping.
G.'s bacillus	Immediate clumping.

Serum A after absorption with G.'s bacillus.

Stock paratyphoid A	Immediate clumping.
K.'s bacillus	,, ,,
W.'s bacillus	,, ,,
G.'s bacillus	No clumping.

Specific A serum after absorption with K.'s bacillus.

Stock A	No clumping.
K.'s bacillus	,, ,,
W.'s bacillus	,, ,,
G.'s bacillus	,, ,,

This series of experiments showed that K.'s bacillus was a true paratyphoid bacillus, as it removed both the specific and group agglutinins from the serum, and also showed that W.'s and G.'s bacilli were not paratyphoid bacilli, as absorption with these bacilli removed only their particular group agglutinin and did not touch the specific.

Another interesting bacillus isolated from fæces gave the following reactions:—

	Peptone water		Nutrose water	
	24 hours	48 hours	24 hours	One week
Lactose	*Nil*	A + G	*Nil*	*Nil.*
Glucose	A + G	A + G	A + G	A + G.
Mannite	A + G	A + G	A + G	A + G.
Cane-sugar	A + G	A + G	*Nil*	*Nil.*
Milk	Acid	Acid	Acid	Acid.

It will be noted that but for the milk tube this bacillus, in the sugars prepared with nutrose water, gave the reactions of paratyphoid B, but in the peptone water sugars gave the reactions of the *colon* group. This bacillus was agglutinated at once in normal saline solution and consequently by all sera diluted with normal saline. Absorption with this strain of bacillus of sera specific for typhoid, paratyphoid A and paratyphoid B removed all the agglutinins from the last but did not touch the other two.

Examples might be multiplied indefinitely, as it was rare for a day to pass without encountering one of these "simulating" bacilli; but enough has been said to show how closely some bacilli may resemble the typhoid group and also how common these bacilli are in the excreta of enteric convalescents.

It might be urged that such careful investigation of each bacillus is not necessary, but it is undoubted that without some such system mistakes will occur. Fortunately, these mistakes when they are made are, as a rule, on the safe side, i.e., bacilli resembling typhoid are taken for typhoid; the converse is not so likely to occur.

The method used in the absorption tests was as follows:—

About 0·5 c.c. of the serum was placed in a watch-glass and the whole of an agar culture of the bacillus to be tested was rubbed up in the serum to form a very thick emulsion. This was then pipetted into a narrow tube which was plugged with cotton-wool, placed in the incubator at 37° C. for three hours, then removed and centrifuged and the clear supernatant fluid used for the subsequent tests, either in sedimentation tubes or simply as a drop on the slide for the macroscopic method, a portion of the cultures being rubbed

up in the drop. By this method quite a number of bacilli could be tested at one time against the specific sera.

There is little doubt that these "typhoid simulators" account for many erratic findings of typhoid or paratyphoid bacilli in the fæces of healthy men, in flies, etc., and work on the detection of carriers should only be attempted by those who have had special experience.

During the nine months of 1908, 310 men arrived at the depot. With the equipment available it was only possible to examine the excreta of 10 men daily, and as it was considered necessary to examine each man at least ten times, it will be understood that it was not possible to keep abreast of the work. Only 190 were examined and returned to their stations, leaving 120 men in the depot at the end of the year still to be examined and about 80 men waiting to be sent up from the plains, for whom there was no accommodation. As soon as the new equipment, consisting of one gross smaller plates (six inch) and a larger incubator, capable of holding eighty such plates, arrived, the number of examinations was doubled and the arrears were soon wiped off.

But it was not until the end of 1909 that it was possible to examine men at once on arrival and for a fortnight before their return to the plains.

During the summer months the men who had been longest in the depot were accommodated in tents, thus making room for fresh arrivals from the plains. At one time there were close on two hundred convalescents in the depot. As already pointed out, had it not been for the reduction in enteric incidence brought about by inoculation, it would have been quite impossible to deal with the convalescents from so many stations. Indeed, in former years, one large station, such as Lucknow or Umballa, would have required a depot of its own, with a whole-time medical officer, whereas the present depot was run by a medical officer in addition to his ordinary duties, which duties in previous years prior to the establishment of the depot had given employment to two medical officers.

In 1909 the medical officer in charge of the depot was struck off duty at the Station Hospital, and in 1910 a second medical officer was appointed for duty in the laboratory and depot.

Out of the 190 men whose examinations were completed by the end of 1908, 5 carriers were detected. Notes on the cases of these men are appended. Two of these men came from Kasauli and were already known to be carriers, 1 was returned in error, 2 only were definite chronic carriers from among

the new arrivals, thus giving a percentage of 1·05. This I consider about the true percentage of definite chronic carriers among young men convalescent from enteric fever. One thousand four hundred and seventy-two samples of fæces were examined and one thousand four hundred and forty-eight samples of urine. Not reckoning repeated examinations of the same man, the typhoid bacillus was only recovered once out of all these samples of urine. One of these men was a fæcal carrier, the other urinary. During the three years following up to the end of the year 1911 no other chronic urinary carrier has been detected either at the Naini Tal or the Wellington depot. It may be urged that some may have been overlooked, but with the urine of this chronic carrier it was only necessary to place a single drop on a plate to ensure a pure culture of the *B. typhosus* on every occasion.

Again, when examining the urine of some boys who were suffering from enteric fever, the *B. typhosus* was recovered from the urine in fifty per cent of the cases during the fever and in early convalescence, although all ceased to pass the bacillus within a month of the cessation of the fever.

Apparently among young men the "chronic urine carrier" is a very rare accident indeed, and fortunately so, because he must necessarily be a greater danger to his comrades than the fæcal carrier.

As at this time (1908) there were two men in the depot, the one Br. S., a chronic carrier (urine) of *B. typhosus*, and the other Gr. C., a chronic carrier (fæcal) of the same bacillus, it was decided to carry out some experiments, with a view to determining the viability of this bacillus under as nearly as possible natural conditions. The results of these experiments have already been published, but are briefly recorded here, as they have a very direct bearing on the problem of the causation and prevention of enteric fever in military service.

Before recording the results of these experiments, a word of explanation is necessary as to the expression used "*B. typhosus* in pure culture." This expression, when referring to a plate culture from fæces is only a relative term and depends on the medium employed.

For instance, if an equal amount of a fæcal emulsion from a typhoid carrier is plated out on:—

(1) Ordinary agar,

(2) McConkey's bile salt neutral red agar,

(3) Conradi's crystal violet medium,

the results might be expressed as follows:—

(1) Plate almost overgrown principally by *coli* colonies; numerous minute typhoid colonies.

(2) Not so many *coli* colonies; typhoid colonies numerous and larger.

(3) Practically a pure culture of typhoid; a few scattered *coli* colonies.

This expression, then, refers to the appearance of a sample of fæces (Gr. C.'s) plated on Conradi's blue medium, and does not imply that there were no *colon* bacilli in the sample of fæces.

Experiment I.

To determine the viability of the *B. typhosus* when voided directly on to the ground in the urine of a chronic carrier.

Br. S. micturated on to a patch of dry ground in the depot.

Result.—Six hours after pollution the *B. typhosus* was easily recovered from the washings of ½ grm. of soil, but thirty hours later could not be found. A not unimportant detail is that the soil was still damp with urine for some hours after the *B. typhosus* had disappeared. The methods used were rough, and intentionally so, as it was not proposed to discover how long a single bacillus could be found, but simply to show how long the urine of a chronic carrier is dangerous after it has been voided on the ground. For this reason more than 0·5 grm. of soil was not used for the experiment. As it was considered that possibly the sun and light had determined the rapid disappearance of the bacillus, the experiment was repeated, but on this occasion Br. S. passed his urine on the ground in the corner of a dark hut. But here also the bacillus could only be recovered from the washings of a small quantity of soil up to twenty-four hours after pollution and not later.

Practically the same result was got with polluted soil kept in the laboratory at room temperature exposed to light but not to sun. The *B. typhosus* was readily found for a few hours but not after one day.

These experiments show that the surface soil is dangerous for some hours, but it is no longer so when dry enough to be blown about as dust.

Very different results were obtained when towelling was soiled with the urine and allowed to dry, as in this case bacilli could be recovered up to ten days or more after the soiling of the material. The reason for this is that on the towels there can be no multi-

plication of *coli* or soil bacteria, and hence no rapid destruction of pathogenic bacilli.

Thus it is evident that the few drops of urine on the underwear of the carrier are a source of greater danger than the bulk voided on to soil or in a latrine pan or urinal tub.

It is a well-known fact that soldiers freely lend and freely take the loan of one another's clothing, *i.e.*, football shorts, etc., and thus many obscure cases of enteric fever may be accounted for.

The experiments with the fæces were also devised to answer questions which are frequently propounded.

If a carrier passes a stool into a dry-earth receptacle, how long does the stool remain infective?

The answer is contained in the following table :—

TABLE.

Date				Result
12.11.8	..	Sample plated out	..	B.T. numerous.
13.11.8	..	,, ,,	..	B.T. + 8 colonies second plate.
15.11.8	..	,, ,,	..	B.T. *Coli* increasing.
16.11.8	..	,, ,,	..	B.T. + ,, ,,
17.11.8	..	,, ,,	..	B.T. + ,, ,,
18.11.8	..	,, ,,	..	B.T. − from outer crust.
19.11.8	..	,, ,,	..	B.T. + from centre.
22.11.8	..	,, ,,	..	B.T. + ,, ,,
25.11.8	..	,, ,,	..	B.T. + ,, ,,
27.11.8	..	,, ,,	..	B.T. −
29.11.8	..	,, ,,	..	B.T. −
1.12.8	..	,, ,,	..	B.T. −
				Not later.

The *B. typhosus* was recovered in large numbers for the first two or three days and it could be recovered from the outer portions of the fæcal mass up to the fifth day, but not later. From the centre of the mass it could be recovered for a fortnight, but not later, even when large pieces of the fæces were emulsified and several plates prepared from the emulsion.

It was found that when *small* portions of the fæces were smeared on blanket, the pathogenic bacteria rapidly disappeared (three to four days), provided that the weather was warm and permitted of the multiplication of *coli*. The fæcal experiments differ from the urine in this point, namely, that in the former, *coli* invariably accompanies the *B. typhosus*.

These experiments with blankets and others on the same lines done at Kasauli and Poona throw a very lurid light on the famous South African blankets, from which "millions" of typhoid bacilli were stated to have been isolated many months after a very problematical pollution.

When the weather is too cold to permit of multiplication of *coli* quite other results are obtained, as in one instance typhoid bacilli could be recovered from contaminated blanket one month after the experiment was commenced.

Two years after the above experiments were performed it happened that there were in the depot at the same time two men, both chronic carriers (fæcal), the one of the *B. typhosus* and the other of the *B. paratyphosus* A. It was thought that it would be useful to repeat some of the previous experiments, using the fæces of the two men as material. The purpose of these experiments was two-fold :—

(1) To ascertain whether, as is generally supposed, the *B. paratyphosus* is more resistant in nature outside the human body than the *B. typhosus.*

(2) To ascertain whether with the added experience of two years' work, and with the aid of the newer media (Conradi's green medium and Fawcus and Padlewski's modifications of the same), it would be possible to recover the bacilli more readily and over a longer period.

It may be said at once that both these questions had to be answered in the negative.

Experiment I.

Private H. : Typhoid carrier ; entire stool passed into gumlah filled with sawdust.

Private M. : Paratyphoid carrier ; entire stool passed into gumlah filled with sawdust.

From time to time 0·5 grm. of fæces was removed, emulsified in tap-water and plated out.

Table I.

	H.'s fæces ; typhoid	M.'s fæces ; A
5.9.10 ..	B.T. numerous..	Paratyphoid A numerous.
7.9.10 ..	A few B.T. ; great increase of *coli*	A few paratyphoid A ; many *coli.*
12.9.10 ..	No B.T. ; pure *coli*	No paratyphoid A ; pure *coli.*
14.9.10 ..	,, ,, ...	,, ,,
21.9.10 ..	,, ,, ...	,, ,,

After one week neither *B. typhosus* nor *B. paratyphosus* A could be recovered from a gramme of fæces taken from the centre of the mass.

Experiment II.

H.'s total stool placed in a sterile stoppered bottle.

M.'s total stool placed in a sterile stoppered bottle.

TABLE II.

	H.'s fæces; B.T.	M.'s fæces; paratyphoid A
20.9.10 ..	225 colonies; no *coli* ..	226 colonies; numerous *coli* colonies.
21.9.10 ..	Nearly pure culture B.T. ..	Failed to find paratyphoid A; numerous *coli*.
23.9.10 ..	32 colonies B.T.	No paratyphoid A; pure *coli*.
26.9.10 ..	A few B.T.	,, ,,
27.9.10 ..	No B.T...	,, ,,
28.9.10 ..	A few B.T.	,, ,,
30.9.10 ..	,, ...	,, ,,
1.10.10 ..	No B.T.; pure *coli* ..	,, ,,
3.10.10 ..	,, ,, ..	,, ,,
7.10.10 ..	,, ,, ..	,, ,,

Ten days after the fæces had been placed in the bottle the *B. typhosus* could be recovered, but not later, whereas the *B. paratyphosus* A could not be found after the third day.

The only difference in the conditions was that at the commencement of the experiment *coli* colonies were much more numerous in the fæces of the paratyphoid carrier than in that of the typhoid carrier.

By a curious coincidence typhoid bacilli and paratyphoid were present in almost identical numbers. During the time that this experiment was being carried out the weather was warm and moist and *coli* multiplied rapidly at room temperature. It is in my opinion this factor which determines the length of life of the *B. typhosus* in nature.

EXPERIMENT III.

During December, 1910, when the temperature rarely rose above 45° F., and multiplication of *coli* did not take place, some further experiments were undertaken with the fæces of Private B., East Surrey Regiment, a chronic carrier of the *B. typhosus*.

A portion of the fæces of Private B. was placed in a stoppered bottle in the godown; 0·5 grm. was removed and emulsified and plated out from time to time.

Results.

23.12.10	3,000 typhoid colonies; four *coli* colonies, "pink" variety.
26.12.10	Typhoid in pure culture.
27.12.10	,, ,,
28.12.10	,, ,,
29.12.10	,, ,,
2.1.11	,, ,,
3.1.11	,, ,,
5.1.11	About twelve *coli* colonies; rest of plate typhoid.
9.1.11	More *coli* colonies.
11.1.11	*Coli* more numerous; great reduction of typhoid colonies; weather warmer.
12.1.11	Typhoid numerous.
13.1.11	,, ,,
	Typhoid still present in March, 1911.

This experiment shows that when the weather is too cold to allow of multiplication of *coli*, *B. typhosus* can be found in the fæces for many days, up to eighty days in the above experiment.

EXPERIMENT IV.

This experiment was undertaken to compare the above results with those obtained when using laboratory cultures in artificial media.

Two loopfuls of twenty-four hours' broth cultures of *B. typhosus*, *B. paratyphosus* A and *B. coli* were placed as follows :—

In 10 *c.c. of peptone water.*

Tube 1, two loopfuls of B.T. + two loopfuls *B. coli.*
Tube 2, two loopfuls of B.T. + two loopfuls *B. paratyphosus* A.
Tube 3, two loopfuls of *B. paratyphosus* A + two loopfuls *B. coli.*

These peptone tubes were not incubated, but were placed in racks on the bench exposed to bright daylight but not to sun.

Results.

10.10.10. One loopful from each tube plated out.
Tube 1, B.T. present ; *B. coli* predominates.
Tube 2, B.T. and *paratyphosus* A both present.
Tube 3, *paratyphosus* A present, but *B. coli* predominates.

3.1.11.
Tube 1, pure culture *coli* ; no *B. typhosus.*
Tube 2, B.T. and *paratyphosus* A both present.
Tube 3, pure culture *coli* ; no *paratyphosus* A.

The colonies of typhoid and paratyphoid could be quite easily distinguished from one another ; the typhoid colonies were larger, whiter, and more opaque than the paratyphoid, which were small, blue, and transparent. As a general rule it is quite impossible to tell colonies of typhoid from paratyphoid. Typhoid and paratyphoid were present in equal numbers.

The above results have been confirmed by no less an authority than Colonel Horrocks, who, in a paper on the viability of the *B. typhosus*, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, March, 1911, refers to our work, and in the conclusion of his article says: "These experiments (*i.e.*, his own) seem to indicate that the duration of life of the *B. typhosus*, as at present recognized, is very short under natural conditions," and again, "If the dejecta contain many *B. coli*, millions of typhoid bacilli disappear in two or three days," a conclusion which, as will be seen above, I had already arrived at and had embodied in my Annual Report for 1910, submitted in January, 1911.

(*To be continued.*)

Clinical and other Notes.

ON THE *DIPLOBACILLUS LIQUEFACIENS* OF PETIT: WITH REPORT OF A CASE SHOWING UNUSUAL DISTRIBUTION OF THIS ORGANISM.

By FRANK E. TAYLOR, M.A., M.D., M.Sc., F.R.C.S., D.P.H.
Clinical Pathologist and Bacteriologist, Queen Alexandra Military Hospital, Millbank.

It is passing strange that the discovery of the causal organism of diplobacillary conjunctivitis was delayed until the year 1896 to be independently discovered in that year by two separate observers, namely, Morax in Paris and Axenfeld in Marburg, especially when we consider that diplobacillary conjunctivitis constitutes one of the most commonly occurring infections of the eye, with a world-wide geographical distribution; that the organism is a large and distinctive diplobacillus readily stained by simple dyes like methylene blue and present in abundance in the conjunctival discharge of affected cases, being easily seen in smear preparations thereof; and, also, that it can be cultivated without difficulty on blood serum, in which it liquefies in such a way as to bring about the characteristic pitting in this medium.

A very closely allied organism which may be considered as a variant of the diplobacillus of Morax-Axenfeld was discovered in 1898 by Petit in three cases of painless superficial serpiginous hypopyon-keratitis.

Morphologically and tinctorially the diplobacillus of Petit is indistinguishable from that of Morax-Axenfeld, but is distinguished from it by its greater range of growth both with regard to media and temperature, growing readily on the common media such as agar and gelatine, the latter of which it liquefies, and at temperatures ranging from room temperature to blood-heat. Hence in practice it suffices when a blood-serum liquefying diplobacillus is met with to inoculate an agar tube, when growth indicates the Petit type, and its absence the Morax-Axenfeld type. The frequency of diplobacillary infection of the conjunctiva may be gathered from the fact that Pflüger and Simon found the diplobacillus in about ten per cent of all patients in Berne, whilst Erdmann encountered 342 cases in Rostock in five years, Axenfeld 529 cases in Freiburg in four years, and over 500 cases were observed in the University Eye Clinic in Bonn in the course of a single year.

During the last two years I have cultivated the diplobacillus thirty-eight times at the Royal Westminster Ophthalmic Hospital, being in seventeen cases of the Morax-Axenfeld type and in twenty-one of the Petit type.

Diplobacillary infections usually run a chronic course, the Morax-Axenfeld bacillus being associated with a chronic angular conjunctivitis or with a chronic blepharo-conjunctivitis, and the Petit bacillus with similar infections and also with cases of superficial serpiginous hypopyon-keratitis. Occasionally they give rise to much more acute conditions, for I have obtained diplobacilli on two occasions from cases of acute suppurative conjunctivitis clinically diagnosed as, and indistinguishable from, gonorrhœal ophthalmia, but in which no gonococci could be discovered.

On the other hand, the infection may be so mild and set up so little disturbance that it escapes recognition, and on several occasions I have obtained cultures of diplobacilli from apparently normal conjunctivæ from which cultures were taken as a routine procedure for prophylactic purposes prior to operation involving a perforating wound of the globe.

Although the diplobacillus may be, and often is, found alone in the conjunctival sac this is not invariably the case, for I have found associated with it one or more (and often several) of the following organisms, namely, *Bacillus xerosis*, *Staphylococcus albus*, *Micrococcus catarrhalis*, Bacillus of Koch-Weeks, and *Sarcina lutea*.

As regards its distribution in the body, it was believed prior to 1897 that diplobacilli were only to be found in the conjunctival sac. In that year Briand published his Paris thesis pointing out that they could often be found in the nose, even in the absence of any sign of conjunctival infection, and his results have been abundantly confirmed by Erdmann, Treacher Collins, and Gifford. In the majority of these cases the nasal mucous membrane was quite healthy, but in a few of them a condition of chronic rhinitis was observed. Erdmann, moreover, proved the virulence of diplobacilli present in the nose, for implanting nasal secretion containing them into the healthy conjunctival sac, proved by cultures to be free from diplobacilli, set up typical angular conjunctivitis swarming with diplobacilli.

Biard considered that the diplobacilli could produce infection of the conjunctiva and he believed that this occurred by way of the lachrymal duct, although Erdmann, while confirming his results, believed it to occur more frequently through infection by handkerchiefs, fingers, etc.

Hitherto extra-ocular distribution of diplobacilli has been confined to the nose, and I am unable to find any mention of it being found in any other situation. In the following case the diplobacillus of Petit was obtained in cultures taken from the throat, and I have therefore thought it worth placing on record.

Corporal E., 4th Grenadier Guards, reported sick on July 6, 1915, complaining of sore throat, with difficulty of swallowing and some stiffness about the front of the neck. There was an intense diffuse redness of the whole pharynx, with a little purulent exudation on the left tonsil, but no sign of membrane could be detected. There was also slight swelling and tenderness of the glands beneath the angles

of the lower jaw. He was sent to the Laboratory at the Queen Alexandra Military Hospital, Millbank, for a bacterioscopic examination of the throat. Swabs were taken and sloped blood serum tubes were inoculated. A gargle of chlorate of potash was ordered. On the following day growth on the blood serum had produced liquefaction with the characteristic pitting, stained preparations showing the presence of typical short, stout Gram-negative diplobacilli in almost pure culture, the only other organisms present being a few Gram-positive micrococci. No Klebs-Löffler bacilli could be found. Attention was now directed to the conjunctivæ, both of which were normal, being quite free from any trace of inflammation, and this was confirmed by Temporary Lieutenant D. Heron, R.A.M.C., Ophthalmologist to the Hospital. Swabs were taken from both conjunctivæ and inoculated on to blood serum, but no pitting resulted. Swabs were also taken from both nasal cavities and similarly treated, and diplobacilli were obtained from the left nostril, but not from the right.

Subcultures on agar from the pitted serum showed a copious greyish-white growth, which microscopic examination showed to consist of staphylococci mixed with large numbers of Gram-negative diplobacilli. By plating on serum the diplobacillus was obtained in pure culture. It was then found to grow readily on agar, producing a yellowish-grey confluent somewhat translucent growth. Growths also occurred on gelatine at 20° C. with liquefaction of the medium.

Two days later the pharyngitis was much less intense, but diplobacilli were again obtained from both the throat and left nostril. A gargle of zinc sulphate (gr. 1, ad. 1 oz.) was now given with instructions to irrigate the nasal cavities. Two days later cultures taken from swabs showed that the diplobacilli had disappeared from the throat but were still present in the nose, and the same findings were obtained on July 17, when the patient returned to duty.

It would thus appear that the pharyngeal infection was a staphylococcal one and that the diplobacilli were not the causal organisms seeing that they still persisted after the pharyngitis had cleared up.

It was also pointed out how speedily the diplobacilli were banished from the throat after a gargle of zinc sulphate had been given, and how persistently they remained in the nose, probably as the result of the difficulty experienced by the patient in carrying out the nasal irrigation with the zinc sulphate lotion.

Finally, considering the absence of diplobacilli from the conjunctival sac, their ready disappearance from the throat and their persistence in the nasal cavities lined by healthy mucosæ, we may conclude that this patient is a chronic carrier of the diplobacillus of Petit in the nasal fossæ and that the diplobacilli obtained from the throat were derived from this source.

UNIVERSAL ARM SUSPENSION.

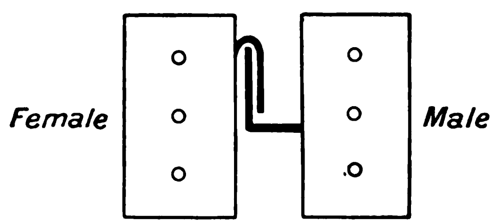
BY MAJOR M. SINCLAIR.
Royal Army Medical Corps.

THIS is composed of a movable wooden top and a fixed wooden perpendicular.

The lower perpendicular pole, L.P. (2 in. by 2½ in.), 5 ft. in length, is fastened to the top of the bed by means of a flat bit of timber, F (4 in. by 1 in.), 2 ft. 4 in. long, and bolted with two bolts to the pole with the bed headrail between them on the extreme right or left of bed.

The pole, L.P., has two sets of hinges, anterior and posterior, to enable it to be used for right or left arm, anterior for left and posterior for right. These hinges are set at 15 in. apart, the upper hinge being 4 in. from the top of pole, L.P. They also allow the top to swing 180°.

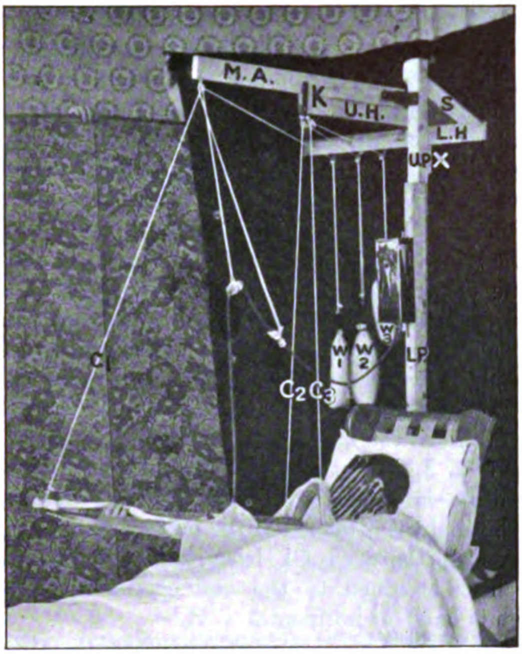
The hinges are composed of two parts—



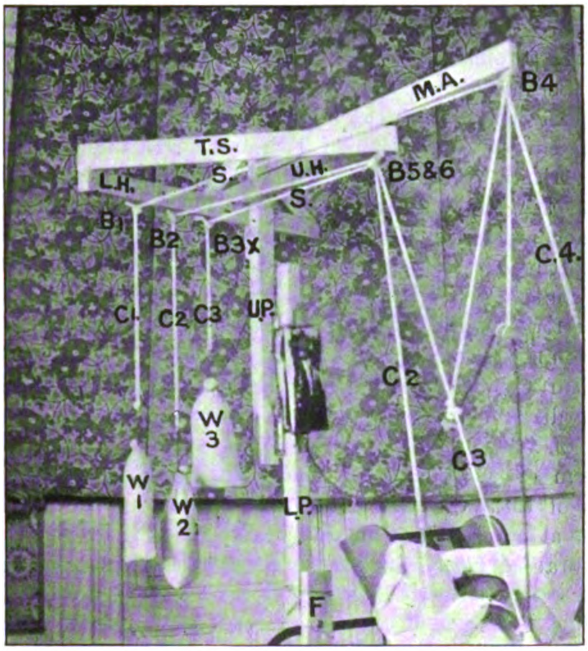
Hinge.

thus allowing the top to be easily moved, when the suspension is required for right or left arm as the case may be. By this method two male parts are fixed to the upper perpendicular, U.P., and four female parts to the lower perpendicular, L.P. In alternate suspensions, male and female parts are reversed. The top has a perpendicular part, U.P., and carries two fixed horizontals, L.H. and U.H., and a movable arm, M.A., which is hinged to the upper perpendicular, U.P. This top can be completely removed from the pole by pushing the top upwards, and thus separating the male from the female hinges. This renders it applicable to right or left arm. The upper perpendicular, U.P., is made of the same material as the lower fixed perpendicular, L.P. (viz. 2½ in. by 2 in.) and is 3 ft. 2 in. in length. The two fixed horizontals, L.H. and U.H., are set at right angles one above the other. They are 2 ft. 8 in. in length, the material is 3 in. by 1 in. They extend 2 ft. in one direction and 8 in. in the other.

The upper U.H. rests on the horizontal L.H., which in turn rests on a block of wood, X, all three being screwed to the upper perpendicular, U.P. From the end of the shorter pieces of these two horizontals, two stays, S. (2 in. by 1 in.), are fixed to the top of the upper perpendicular to counteract the weight that has to be applied to the longer ends. No



Showing arm suspension applied.



Arm suspension, showing details.

dovetailing is done so far to avoid any weakening of the superstructure. The ends of the longer pieces of the two horizontals are joined by a piece of wood, T.S. (3 in. by 1 in.), and, in order to keep this level, it is let in at the end which is in contact with the higher of the two horizontals and rests on the top of the other horizontal. At each end of this transverse stay, T.S., is a flat iron upright (4½ in. by 1 in. by ⅛ in.) projecting upwards to act as a check, K., to the movable arm and at the same time give more strength to these joints.

The movable arm, M.A. (3 ft. by 1 in.), is hinged to the upper perpendicular, and the upper edge 4 in. from the top of U.P. moves through an angle of 90°. It is for the attachment of a block when the arm is extended, as in an arm "Thomas" splint. When the arm is extended (as in the photograph) in an arm "Thomas," there are three eyes of wire fixed to the splint, two at the ring (one on each side of the iron bars of the splint), and the third at the middle of the transverse bar at the hand end. Three cords, C1, 2, 3, are attached to these eyes—watch-chain hooks are very convenient—and each passes through its respective two blocks, while a suitable weight is attached to the other end.

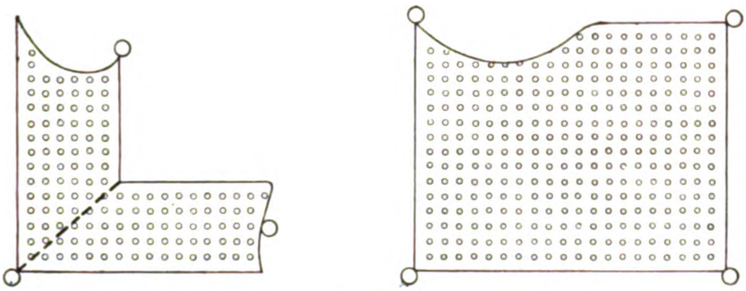
For a right arm the cord C1 from the hand end passes through block B4 which is attached to the end of the M.A., then passes to block B1, which is fixed to horizontal L.H.

It has been found since this photogtaph was taken that block B1 is better fixed at the other end of lower horizontal L.H., so as to immobilize the arm, M.A., and a weight (sandbag) of about 2 lb. is attached at the other end. The cord C2 is attached to the outer eye at the ring end of the splint, passes through block B5 which is fixed at the junction of T.S. and U.H., then through block B2 on L.H. and carries a weight of about 4 lb. Cord C3 passes from the inner eye of the splint through the other block B6, fixed at the junction of T.S. and U.H., thence to block B3 on L.H. and carries a weight of about 6 lb. The blocks B1, 2, 3, should be so placed on L.H. as to allow free play of the weights without touching.

In the accompanying photographs, the irrigator rubber tube and two cords supporting the tubing which is leading to a wound that is being treated by continuous irrigation are not lettered to avoid confusion. A gutter of perforated zinc is fixed to the sides of the "Thomas," and holes are burned in the zinc opposite any drainage-tubes. To prevent tissues herniating through these exits, the holes should not be too large. The whole is sterilized by flaming, and the arm with wounds is laid directly on this bed of zinc.

This form of suspension of the splint conforms to all permissible movements of the limb, and is a great comfort to the patient, who is free to move at his will or to sit up by his bedside if he wishes. Wounds so treated, drained freely, are readily dressed and are open to inspection at all times.

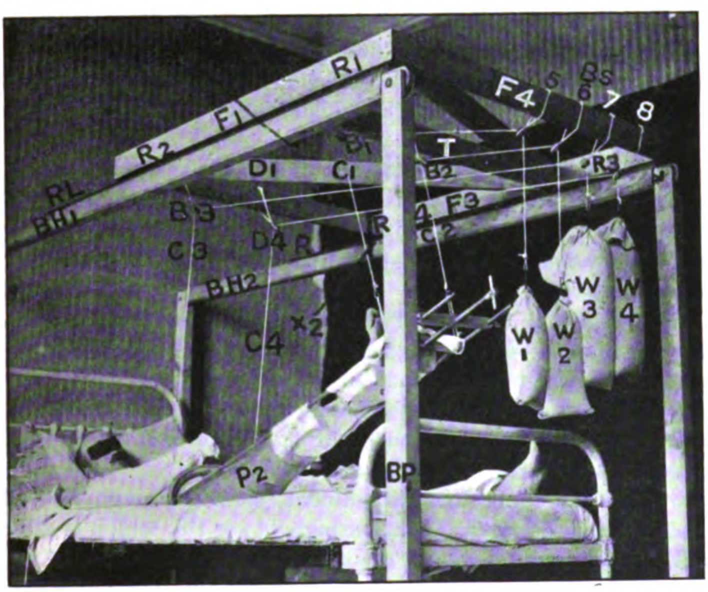
By redistribution of the weights and blocks this suspension can be adapted to a rectangular wire splint or a square wire frame, both of which are filled in with perforated zinc, for use with the flexed elbow.



Wire splint.

UNIVERSAL LEG SUSPENSION.

The suspension consists of a fixed frame carrying a travelling cradle from which the limb in its splint is suspended by a system of weights and pulleys.



Leg suspension applied. P.z., perforated zinc.

Frame.—Material, 3 in. by 2 in.

A length of T section iron rail is screwed to the upper surface of an 8-ft. wooden bar for a distance 5 ft. 6 in. from the foot end.

Two such bars are supported at their extremities by 6-ft. uprights placed so that the rails are 3 ft. 3 in. apart and parallel to each other.

The uprights are firmly fixed to the floor by suitable stays, and the pair at the head end are joined by a transverse bar.

Cradle.—Material, 3 in. by 1 in.

All dimensions are outside measurements.

The travelling cradle is rectangular with sides F1 and F3, 4 ft. in length, carrying two window-sash pulleys, each let in 4 in. from the extremity R1, 2, 3, 4.

The ends F2 and 4 are 3 ft. 4 in. in length.

This rectangle is divided by a transverse stay T. at 1 ft. 5 in., and the two smaller rectangles thus formed have diagonal stays, D1 and 2, to prevent tacking and give rigidity. On F2 and T. iron checks, X2 and 1, (6 in. by 1 in. by ⅛ in.) project vertically downwards, just clearing the horizontals B.H.1 and 2. Strong 2-in. screws are fixed half-in into the inner sides of B.H.1 and 2 to engage with these checks.

These are best adjusted experimentally. Sixteen round-headed 2-in. screws are fixed half-in into the upper edges of F2, T. and F4 in the following way (diagram of suspension). On F2 four screws at the sixth and fifteenth inch from each side.

On T. four screws at the second and eleventh inch from each side.

On F4, eight screws at the fourth, ninth, fourteenth, nineteenth, twenty-first, twenty-sixth, thirty-first and thirty-sixth inch.

There are now sufficient for a right and left leg and are for the attachment of the single blocks of the Hodgen's splint (1½-in. block is the best size).

In slinging a right fractured femur in a Wallace's splint, as in photograph and figure, blocks are attached to screw S1, 2, 5, 6, 13, 14, 15, 16.

There are 4 eyes of wire fixed to the splint: 2 on the ring (1 on each side below the bars of the splint), and the other 2 to the transverse bar carrying the foot piece.

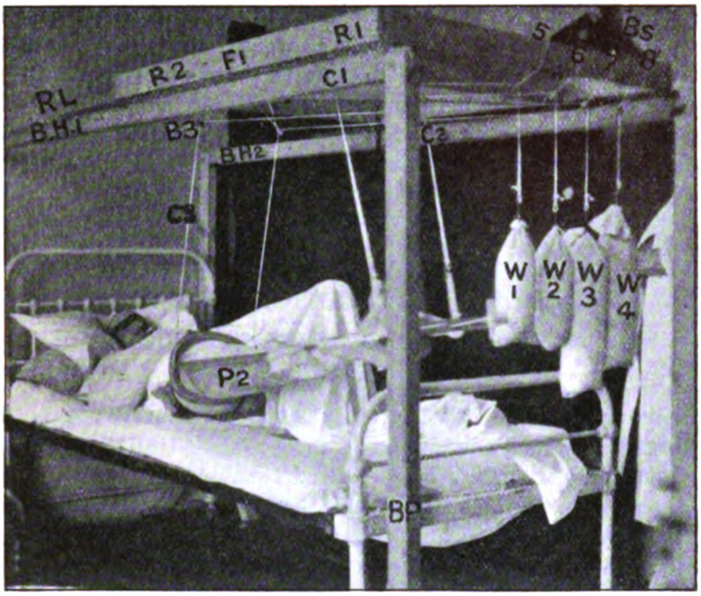
Four cords, C1, 2, 3, 4, are attached to these eyes—watch-chain hooks are very convenient—and each passes through its respective two blocks, while a suitable weight is attached to the other end.

Cord C1 from outer foot attachment passes through block B1 which is attached to screw S5 on T., then through block B5, which is attached to screw S13, and carries a weight of about 7 lb.

Cord C2, from inner foot attachment, passes through B2, which is attached to screw F6 on T., then through block B6, which is attached to screw S14, and carries a weight of about 7 lb.

Cord C3 from outer ring attachment passes through block B3, which is attached to screw S1, then through block B7, which is attached to screw S15, and carries a weight of about 14 lb.

Cord C4, from inner ring attachment, passes through block B4,



Showing patient raising pelvis unaided four days after injury.

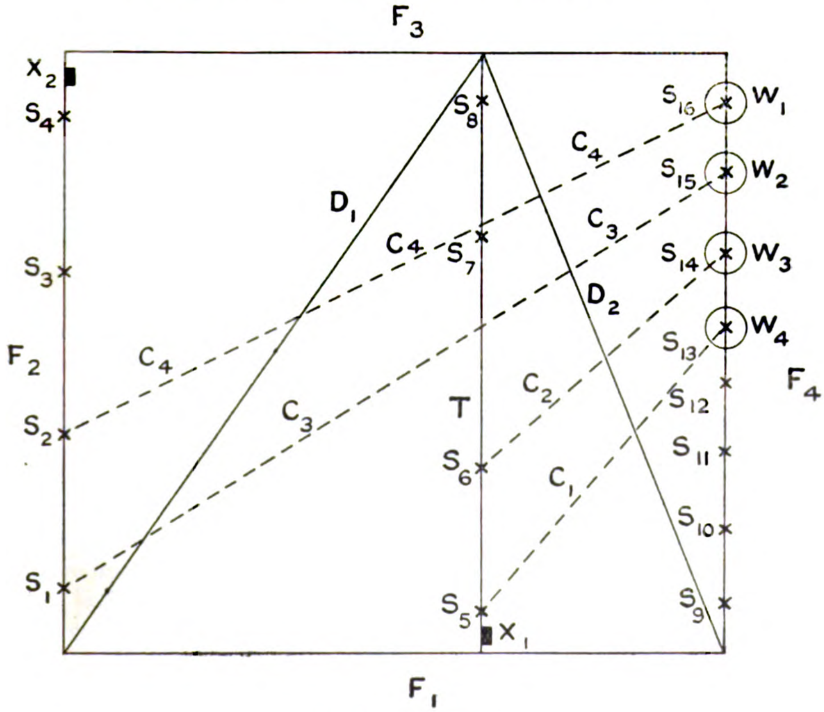


Diagram of suspension.

which is attached to screw S2, then through block B8, which is attached to screw S16, and carries a weight of about 14 lb.

This suspension allows the patient very free movement, is a great comfort to him, and nursing is made comparatively simple.

The second photograph shows the patient, who has a fractured femur and ulna, raising his pelvis unaided four days after injury.

REMOVAL OF A SHRAPNEL TIME-FUSE FROM THE LEFT SHOULDER. DESCRIPTION OF A SPLINT.

By Lieutenant A. E. MORTIMER WOOLF.
Royal Army Medical Corps.

In removing foreign bodies from various parts of the body, I have often noticed the rarity of finding a piece of shell of any considerable size. Quite large wounds may be caused by a projectile of astonishingly small dimensions. Previously to this case the largest piece of shell I have removed had penetrated the knee-joint, completely severing the internal condyle of the femur from the rest of the bone. In this case the portion of shell did not measure one cubic inch. The lodgment of a complete shrapnel time-fuse in almost perfect condition is an event of such rare occurrence that it seems to be worth while placing it on record.

The patient was wounded on May 25, at about 2.30 p.m. He is a stretcher bearer and was going up to the trenches to collect wounded. He advanced to within about four yards of his destination when he heard the shriek of a shell approaching. He turned his back on the trenches and almost immediately felt a severe blow on the back of the left shoulder. The blow did not knock him down, but caused him to stagger and then, as he somewhat naively expressed himself, "it set me running." He reached a ditch about one hundred yards away, where he fell down and in about twenty minutes was removed to the dressing station, where his wound was dressed and painted with iodine. That night he was taken to the clearing station, where, under an anæsthetic, a tube was inserted. On the following day he was sent to another clearing station and then despatched on the train, arriving at a General Hospital at the base three days after the reception of the original injury.

On admission, the patient was in considerable pain, much more so than is usually the case. There was a wound over the posterior border of the deltoid about one and a half inches long, through which a tube had been inserted. The other end of the tube appeared through a much smaller wound situated over the pectoro-deltoid interval. This wound looked like an operation incision, and the patient thinks was not caused by the original injury.

Owing to the severity of the pain he was taken to the theatre almost immediately. On inserting my finger into the posterior wound, I encountered a round smooth object which for the moment I thought was the head of the humerus, dislocated and externally rotated. On retracting the edges of the wound, I saw the piece of brass at the top of the round part of the time-fuse, and immediately recognized the cause of the trouble. The fuse was tightly impacted and the greatest convexity was situated about three-quarters of an inch from the surface. The wound had to be enlarged considerably to allow of removal which was

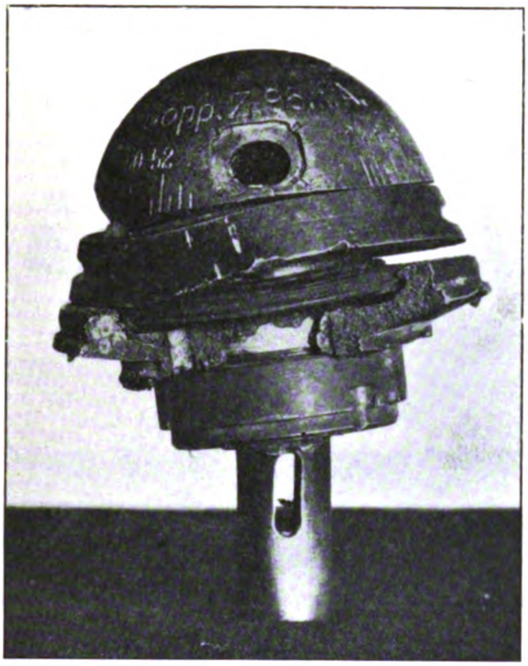


FIG. 1.

accomplished without difficulty. There was a comminuted fracture of the humerus below the surgical neck; some loose fragments of bone were removed and the sharp pointed ends of the upper and lower fragments were excised with bone-cutting forceps; drainage was provided for.

The fuse was lying with the stem against the bone. The fracture, though a severe one, was not nearly so comminuted as that caused by many a smaller piece of shell. On removal there were septic pieces of muscle attached in the cracks of the split metal and the odour was most revolting. The photographs show two views of the specimen in nearly

perfect condition. The stem of the fuse was lying nearly horizontal, with a slight inclination downwards. I suspected that the injury was due to a ricochet, but on questioning the patient afterwards, he was unable to throw any light on this question. The weight of the fuse is ten ounces.

In the treatment of compound fractures of the upper end of the humerus due to projectiles two difficulties are encountered:—

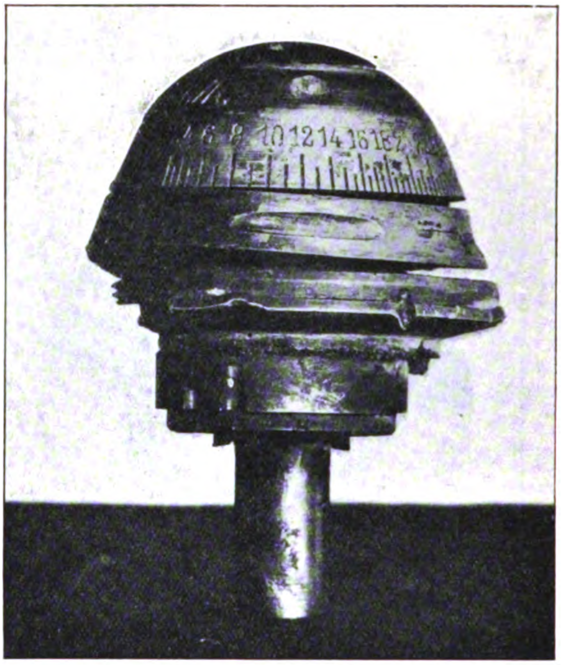


FIG. 2.

(1) The application of a retentive apparatus.

(2) The dressing of the wound, without it being necessary to remove the splint.

For fractures below the shoulder the modified Thomas's splint is excellent and fulfils both these requirements, at the same time allowing the lower fragment to be placed in any degree of abduction necessary. It is unfortunately not applicable to wounds high up as the circular band interferes with the dressing. In order to obviate this, a splint of the Thomas's variety but modified, I believe by Mr. Robert Jones, has been supplied, with the upper collar so made that it fits closely to the neck, and so gives access to the wound. The one drawback to this splint is

that it is impossible to abduct the lower fragment and at the same time prevent internal rotation.

In order to obviate these difficulties I have adopted the following plan: A piece of perforated zinc plating, measuring 23 in. by 8½ in., and supplied in the Army fracture boxes, is cut for about 1½ in. on both sides, and in two places, one about 7½ in. from the end of the plate, and the second about 6 in. from the other end. The plate so cut is bent as

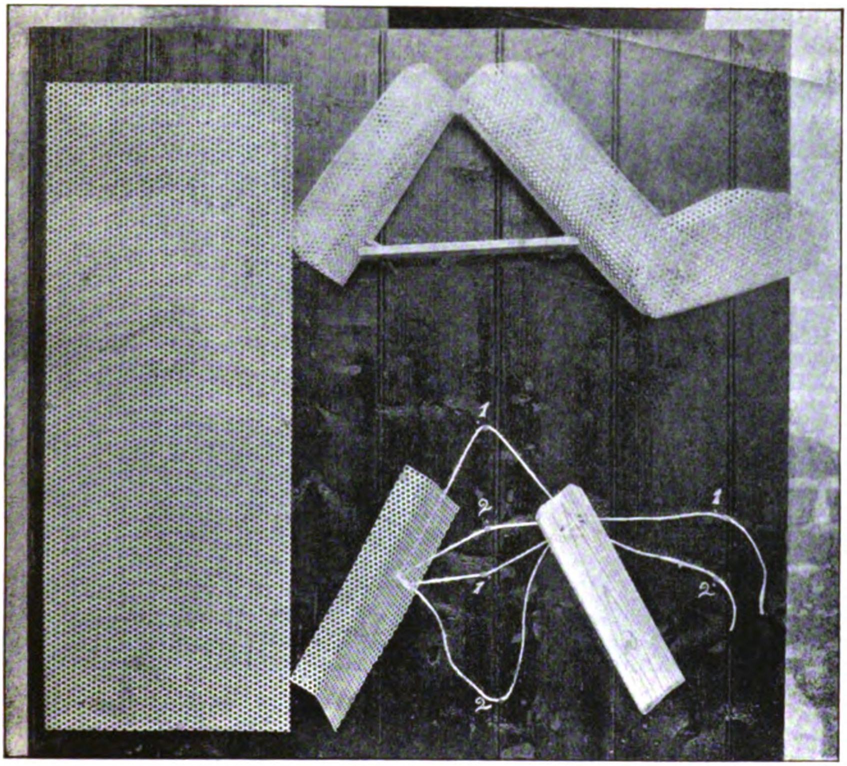


Fig. 3.

shown in the photograph, so that a thoracic piece, arm piece and forearm piece are formed. The position of the actual cuts should be determined roughly by measuring of the patient.

The cuts are easily made by any strong pair of shears, such as plaster of Paris shears or even a strong pair of scissors. The very flexible plating is now moulded to the shape of the parts to which it is to be applied, and is cut away where it interferes with the subsequent dressing. The sharp corners are rounded off, and rigidity is obtained by the following methods :—

(*i*) Two holes are bored at each end of a piece of wood about seven and a half inches by two and a half inches. A piece of string is threaded through the two holes, passed through two opposite holes in the zinc plating, the ends crossed over and threaded back again through the zinc plating into the holes in the wood. By this means, the string end which was originally threaded through the right-hand hole in the wood, finally emerges through the left-hand hole. The wood is then firmly fixed by tying at both ends. The distance between the middle of the wood and the apex of the axillary piece should be about four inches, so as to allow

FIG. 4.

a bandage to be passed easily through this space. The forearm piece which is bent up will allow holes in the plating of this portion to come into opposition with holes in the arm piece, and string is threaded through in precisely the same way as described above, on each side, in order to secure rigidity between the two pieces.

(*ii*) The thoracic piece should be bandaged to the chest separately, and before starting to bandage the arm. The arm is bandaged over the highest point of the shoulder and under the axillary piece and then down the arm and forearm. In dressing the case, it is only the latter bandage that is removed; the bandage fixing the thoracic piece to the chest keeps the splint in position while the dressing is carried out. Extra security

can be obtained by passing a triangular bandage under the axillary piece and tying over the shoulder of the opposite side, as shown in the photograph.

I have now used this splint on twelve cases and have found it very satisfactory. It is easily applied while the patient is under the anæsthetic, and takes about fifteen to twenty minutes to complete.

By making each splint at the time of operation, the individual requirements of a particular case are catered for. After the operation the patient is quite comfortable, rigidity is adequate, and subsequent dressing much facilitated.

A PORTABLE "BED-REST" STRETCHER.

By Major ERNEST FINCH.
Royal Army Medical Corps (T.F.)

The desirability of placing men, suffering from wounds in the chest and abdomen, in a sitting position, is well recognized. The "bed-rest" attitude is also adopted in treating diseases of the chest, and men suffering from the effects of asphyxiating gas. Another point to be emphasized is, that this sitting posture should be maintained while the patient is being moved from one place to another, in the same room, building, or by convoy.

With ordinary regulation (Mark II) stretchers this may be done by devices, such as a pile of blankets, a box, or some other equally inconvenient makeshift.

The problem presenting itself was, then, the construction of a portable stretcher on the bed-rest principle.

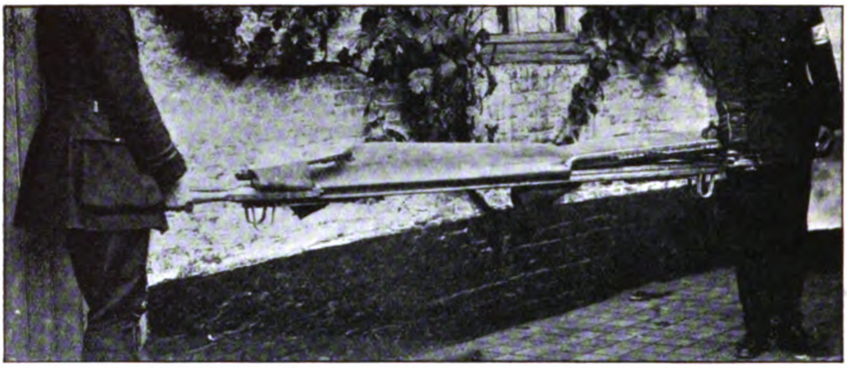
This has been solved for me by Lieutenant B. G. Bouwens, A.S.C., M.T., who is in charge of a workshop unit at the front. It will carry a patient in any position, from lying flat to sitting up, either by bearer or in an ambulance. There is no mechanism which can get out of order, or stick up with mud, rust, or misuse.

The poles of the bed-rest are triangular in shape, and so placed that with the foot-rest it is improbable that a patient will roll off. The main strain on the canvas will be beneath the buttocks; an extra strip of canvas is placed here, which adds to the durability of the stretcher. The foot-piece is adjustable, so that the stretcher can be used for a short man as easily as for a tall one.

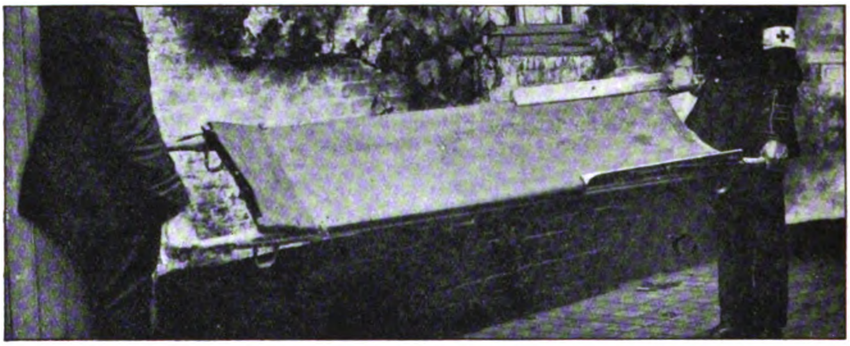
The following is a brief description:—

Parallel to the main poles of the stretcher are hinged two pieces of wood, forming the poles of the rest, triangular in shape, two feet three inches in length.

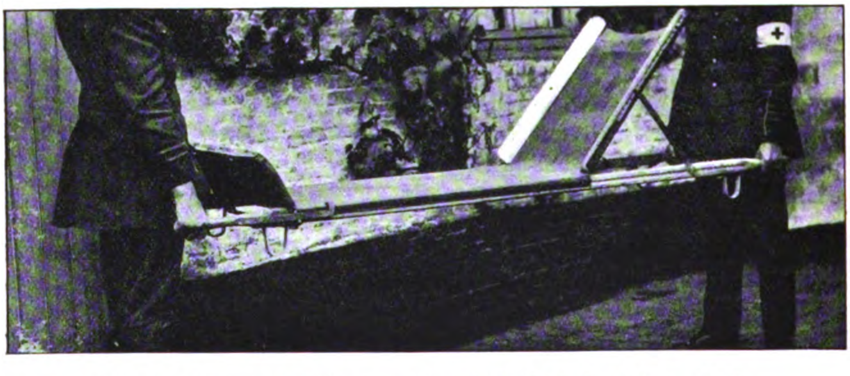
The canvas is fixed in its upper part to the hinged poles of the "rest," and in its lower part to the main poles of the stretcher. The upper part



The stretcher closed: a strap secures the bed-rest to the poles.



The stretcher prepared for a lying down case.



The stretcher prepared for a case for which the bed-rest is required.

is therefore capable of being set at a varying angle to the lower, without interfering with the carrying position of the stretcher poles, which are permanently horizontal.

Adjustable metal props are provided, to vary the inclination of the bed-rest, and, when closed, fold down just clear of the carrying handles. The two hinged poles are kept open by a traverse bar.

The foot-rest consists of curved iron uprights, kept open by a traverse bar. Canvas is stretched between them. The uprights are shaped to engage with pins in a rack when open, so that the position can be adjusted to the height of the patient. The whole foot-rest can be folded flat, if an ordinary lying down case is on the stretcher.

There is no difficulty in completing "close stretcher."

The cost of converting an ordinary (Mark II) stretcher into the "bed-rest" variety works out at three francs a stretcher.

The weight is forty pounds, compared with thirty pounds which is the weight of an ordinary regulation stretcher.

It takes a little longer to open and place the stretcher in position than it does when working with the regulation type, but it folds up to about the same size.

In conclusion, I must thank the officers of the 3rd West Riding Field Ambulance for many suggestions, and Lieutenant Bouwens for the trouble and time he and his workshop unit have taken.

The value of the stretcher is undoubted, and already, in many cases, it has filled a much felt want, and has been a boon to wounded men in the field ambulance hospital.

Translation.

ON THE USE OF PORTABLE KITCHENS (DES CUISINES ROULANTES) AS APPARATUS FOR DOUCHES AND STEAM DISINFECTION IN THE FIGHTING LINE AND IN ARMY CORPS (DANS LES SERVICES DE L'AVANT ET LES CORPS DE TROUPES).

By M. le Dr. CHAUCHARD.

Typhus and recurrent fever (la fièvre récurrente) have at all times been dreaded scourges of armies in the field. We know that they are spread by lice. Many means of destroying lice have been advocated; the only one of indisputable value is the steam stoving of clothing and linen, together with and at the same time as bodily cleansing by hot soapy douches, followed by the rubbing in of antiseptics. The construction of steam stoves in regiments in the fighting line appears, at first sight, practically impossible, and so this process is not used. However, all army corps have at hand first-class apparatus, admitting the establishment, without expense, and in a simple and practical way, of a service of douches and disinfection. This apparatus is the portable kitchen.

As Senior Medical Officer (*Medicin-chef*) of a regiment in the first line, I am using with complete success this means of disinfection, and that by adapting to the portable kitchens an arrangement small in cost and within the reach of all.

(1) *The Steam Stove.*—At the disconnecting pipe (or at the safety valve, previously unscrewed) of one of the boilers an elbowed pipe is fixed. The free end of this passes through an opening in the upper part of one of the staves of a large barrel (those which I use have a capacity of five hundred litres). The upper end of this barrel has been taken off, and made into a lid, on the lower side of which are hooks on which the clothes are hung. This lid is raised by means of a pulley. The lower end of the barrel is pierced with holes for the escape of air and the exit of steam. The boiler is half filled with water and heated by coal or coke. The steam is conducted by the elbowed pipe into the barrel, of which it fills the upper part first, as its density is less than that of the air. Little by little, in proportion as the pressure increases, it drives the air, after the manner of a piston, towards the lower part of the barrel. Thus, in a few minutes, the air is completely driven out. At this moment the thermometer placed in the interior of the lower part of the receptacle rises to 100° C., and remains there as long as the steam is given off. The parasites and their nits are destroyed in fifteen minutes from this time.

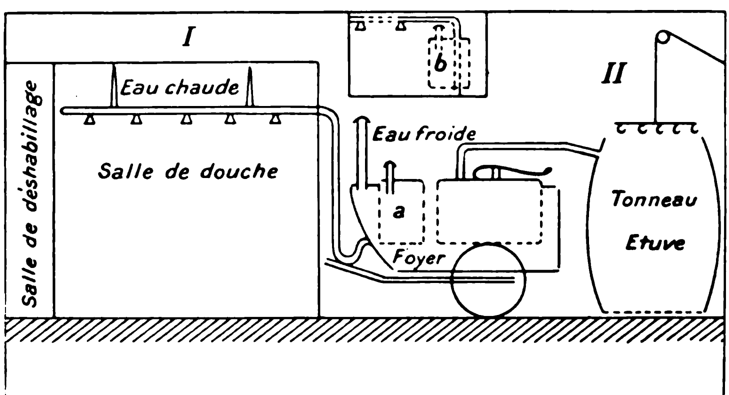
This apparatus provides for the stoving of the clothes and linen of one hundred men per hour. Failing a barrel, a wooden case could be arranged covered with sheets of zinc or light sheet iron.

(2) *Douche Installation.*—There are two types of portable kitchens:—

(*a*) Boilers with outlet tap at the bottom and with covers fastened at the centre by means of a lever and a spiral spring.

(*b*) Boilers without a lower tap and with covers fixed by means of bolts (autoclave system).

First type; boiler with outlet tap (scheme *a*). The cold water comes in by the disconnecting pipe; this water is supplied either by a pre-existent system of pipes, or from a barrel raised up (four to five metres), acting as a reservoir. A hose of canvas or rubber is fitted to the lower outlet tap, and at its other extremity there is fixed an iron or lead pipe bearing every eighty centimetres a watering rose (total, five on the apparatus I set up). The spiral spring is blocked by means of two wooden wedges to stop escapes between the cover and the boiler.



Second type (scheme *b*). The water comes in in the same way. To let it out a hole has been made in the cover which permits the introduction, down to the bottom of the receptacle, of an outlet tube for the water, which is connected with the pipe carrying the roses by means of a hose of canvas or rubber.

The boiler is filled with water and heated. In a few minutes a continuous flow of hot water is obtained, the temperature of which is regulated as required by opening the inlet tap more or less, or by varying the intensity of the heat of the fire.

Two men take their douche under each rose, soaping one another. Each douching takes five minutes, so we douche more than one hundred men per hour.

To make this apparatus there is needed: A tap for the inlet of the water, six metres of iron or lead piping, five roses, one and a half metres of rubber or canvas hose, a barrel, and, in the type of boiler without a tap, there is required besides an adjustment for the opening pierced in the lid. The cost of all these fittings is negligible, considering that the

allowances (les circulaires allouent) to army corps for douches is 45 centimes per man per month, which, for a regiment of three thousand men gives a monthly credit of 1,350 francs.

These fittings are set up in a large room (une salle) or hut, six metres by four, in one corner of which an undressing closet has been arranged by a boarded partition; the "kitchen" remains outside. In cases where the ground is not cemented it will do to make an open flooring over light beams, which would permit the water to run away.

Up to the present I have installed five stations, one of which is working in a ravine, sheltered from artillery fire, about five hundred metres behind our trenches. The officers and men of the companies in the first line are its assiduous clients. To the others there come, besides the men of the reserve companies of my regiment, men from neighbouring regiments; four regiments of infantry, artillery, army service corps (du train des équipages), engineers, etc., the German prisoners of the Division; in all more than ten thousand men.

Two men suffice for the service of each of these stations; a stoker, capable, in case of need, of doing soldering, and an orderly (stover) taken from a resting company.

Each infantry regiment has four portable kitchens, two to each battalion, the regiment consisting of two or three battalions. It is thus easy to arrange among them a sanitary service which will fit in with the cooks' hours, as setting up and taking down the apparatus only occupies the work of a few minutes.

Current Literature.

The Ætiology of Typhus Exanthematicus (H. Plotz, P. K. Olitsky and G. Baehr. *The Journal of Infectious Diseases*, vol. xvii, No. 1, July, 1915).—This paper is divided into three parts: (1) Bacteriological studies; (2) serological studies; and (3) experimental studies.

The first part of the paper deals with the work which led up to the discovery by Plotz of the organism of typhus fever. The epidemic form of typhus is characterized by its comparatively mild course, and low mortality. This disease is known in America as Brill's disease. Louria and Friedman have published papers pointing out the resemblance between this disease and cases of mild typhus which they had seen in Europe.

Striking cross-immunity experiments have been described which show that a cross-immunity exists between monkeys infected with Brill's disease and those infected with Mexican typhus.

In the search for the ætiology of typhus fever one of the most important aids was the fact that the virus of typhus had been found in the circulating blood during the febrile period of the disease. The work of Nicolle, Ricketts and Wilder, Gavino and Girard, and of Anderson and Goldberger, all pointed to the fact that the virus of typhus is not filterable.

Ricketts and Wilder described a bacillus which they saw in blood films stained with Giemsa's stain. Plotz says that this bacillus bears a certain morphological resemblance to the organism which he has cultivated.

It has been surmised that since typhus had been proved to be an insect-borne disease, a protozoan origin would be found, but Ricketts and Wilder called attention to the fact that the rat-flea carries the bacillus of plague, as does the tick the spirillum of African tick fever.

The same authors also pointed out that typhus is an acute, self-limited disease, and that one attack confers immunity, a feature characteristic of many bacterial diseases but extremely unusual in protozoal infections.

These facts led to many attempts to cultivate the virus from the blood in cases of typhus fever, and for this purpose aerobic methods were used with uniformly negative results. The media used were plates of agar and glucose agar (often with ascitic fluid added), flasks of broth, and two per cent glucose broth with and without ascitic fluid.

Plotz not only repeated the aerobic methods, but also used anaerobic methods of cultivation. His method of culturing was as follows :—

Fifteen cubic centimetres of blood are drawn from a vein in the antecubital space with the usual aseptic precautions. For the aerobic method he poured two plates of agar and two of glucose agar. The remainder of the blood was distributed in one or more flasks (one hundred centimetres) of broth, and two per cent glucose broth. The agar used was of two to three per cent concentration, prepared with Liebig's meat extract, and of 0·9 to 1·1 per cent acidity. Two cubic centimetres of blood were added after the agar had been melted and cooled to 40° C. It was well mixed and the plates poured. Rabinowitsch's method, consisting of five cubic centimetres of blood added to one hundred cubic centimetres of equal parts of broth and ascitic fluid with four per cent glycerine added, was also tried.

These all gave negative results, although four of the cases from which blood had been taken afterwards gave a positive result with the anaerobic method of culture.

Plotz in the early part of this study tried many methods of anaerobic cultures which failed. The first successful results were obtained by the use of the ascitic fluid, kidney tissue, and liquid paraffin medium of Noguchi. By this method he obtained the organism in two cases of epidemic, and in one case of endemic typhus fever. The method of Liborius-Veillon proved more satisfactory — modified in that serum glucose agar was used instead of glucose agar. Plotz uses tubes fifteen centimetres long by two centimetres wide, each containing about twenty cubic centimetres of two per cent glucose agar. The agar is made in the same way as for the aerobic method of cultivation. Eight tubes are used for each blood culture. The medium is melted and cooled to 40° C., and into each tube three cubic centimetres of blood are injected directly from the syringe and to the mixture four cubic centimetres of ascitic fluid are added. The contents are mixed by pouring from one sterile tube into another, care being taken not to introduce any air bubbles. The contents are allowed to cool at room temperature, or better still by immersion in ice-water, and then a layer of plain agar

two centimetres deep is added to each tube. The tubes are then incubated at 37·5° C.

The success of the culture depends greatly on the selection of the serum. It was found that only such sera should be used as are bile-free and have a specific gravity of 1015 or over.

The sterility of the ascitic fluid must be ascertained by aerobic and anaerobic culture.

Colonies appear in from three to sixteen days. They can be removed from the tube by breaking it across, and subculturing into slopes of 0·5 per cent glucose serum agar (a quarter the volume of serum), and placing the inoculated tubes in Buchner tubes.

The colonies usually appear in the lower two or three centimetres of the tubes. Each colony first appears as a small opaque spot; as it grows a brown area of precipitation develops in the media about it. The colony itself varies from one to six millimetres in diameter (including the area of precipitation). In cross-section it is Y-shaped, brownish in appearance, and soft in consistency. The arms of the Y are fusiform.

The organism is a small pleomorphic, Gram-positive bacillus, non-motile, not capsulated, not acid-fast, and does not form spores. Its length is from 0·9 to 1·93 μ, breadth from one-fifth to three-fifths of its length. Most of the organisms are straight though occasional ones are slightly curved. Coccoid forms also occur. Degeneration and involution forms appear early.

As to its cultural characteristics besides the usual cultures in Buchner tubes, a variety of media in long tubes (20 cm. long by 1·25 cm. wide) have been used. The tubes were inoculated with a saline emulsion, and incubated at 37° C. for twenty days. The best growth was obtained in two per cent glucose agar with ascitic fluid added, the growth extending up the tube to within 2 to 2½ cm. of the top of the medium. Precipitation takes place after the growth becomes profuse.

On potato, after four days, an invisible white growth forms, which is demonstrable on scraping the medium. There is no growth on gelatine. The organism produces acid in glucose, maltose, galactose, and inulin with precipitation, but no visible gas is formed. There is no change in raffinose, mannite, arabinose, saccharose, dextrin, or lactose. It produces slight acidity in milk in eighteen days. Superficial colonies when they appear on plates, which is not often, are opaque, 1·5 to 2 mm. in diameter, with fading, irregular edges. Each colony is surrounded by a zone of fine, dust-like dots, localized in an area of precipitation. The colonies are cream by reflected light and opaque by transmitted light. The deeper colonies vary in size from a pin-point to 1 mm. In shape they are round, oblong, or triangular, the last shape prevailing.

It is worth noting that Plotz says that for keeping the organism alive 0·5 per cent glucose agar is used, as the larger glucose content is presumed to decrease the virulence to a greater extent. The organism is an obligatory anaerobe. Its thermal death-point is 55° C. for ten minutes, which coincides with the thermal death-point of the virus that Anderson and Goldberger demonstrated in the blood of typhus patients. An emulsion of the organism when passed through a Berkefeld filter, size N, fails to produce any growth in 0·5 per cent glucose serum agar, while a control of the emulsion not so passed does so.

The general result of blood cultures was as follows:—

In epidemic cases, the blood of seven cases being cultured, the organism was recovered from all in pure culture, during the febrile stage. In endemic cases the bacillus was recovered in fifty-three per cent. The cultures were taken on varying days of the disease up to the day of the crisis.

Blood cultures were made in six of the epidemic cases after the crisis, and all proved negative. In nine endemic cases cultured after the crisis two yielded the bacillus, one twelve hours and the other thirty-six hours after the crisis.

The authors of this paper also made anaerobic cultures from one hundred and ninety-eight other febrile cases. These represented a variety of conditions such as typhoid, acute osteomyelitis, acute rheumatic endocarditis, chorea, acute nephritis, influenza, liver abscess, splenic anæmia, etc. In none of these cases was an organism recovered in any way resembling the bacillus isolated from cases of typhus fever.

As to the day of disease on which the most marked bacteriæmia was present, it was found to be impossible to determine the day of onset in the patients from whom blood was taken. It was, however, found that the best results were obtained four or five days before the crisis. In cultures taken from the blood of inoculated animals the organism was most frequently found when the blood was taken early in the disease. This probably holds good in man also.

There seems to be a marked relation between the amount of bacteriæmia present and the severity of the disease. The bacillus was found eighteen times as abundantly in the epidemic as in the blood of the endemic cases.

The serological studies are dealt with by Olitsky. He discovered the presence of complement-fixing antibodies against the isolated bacillus only in the cases of typhus fever, and in no other diseases. After some preliminary experiments he used an antigen consisting of the filtrate of a killed, autolyzed emulsion of the bacillus of typhus, using a mixed emulsion of both the epidemic and endemic strains.

Eleven cases of epidemic and 34 cases of endemic typhus were tested. Nine of the epidemic and 30 of the endemic were tested after the crisis. Of these the total number of positives was 28, or 71·8 per cent. Of all the cases tested irrespective of the stage of the disease the total positive results were 29, or 64·4 per cent.

At the height of the disease 25 cases were tested, and only 2 positive results were obtained. Ten cases were tested at the crisis, and 4 were returned as positive; hence we see a tendency towards an increased number of complement-fixing antibodies at the crisis. All the controls gave negative results, and covered a number of acute febrile diseases. For agglutination estimation he uses the microscopic method rather than the macroscopic, for these reasons :—

Large quantities of the bacilli necessary for suspensions as agglutinogens are difficult to obtain, owing to the sparse growth of organisms and the strict anaerobic conditions required. The bacillus even without the addition of serum has a marked tendency to clump on standing. Also, where there is a positive result with the macroscopic method there is always a positive one with the microscope, and this method conserves the serum.

The serum used is inactivated at 56° C. for half an hour. The

final dilutions used are 1 in 20, 1 in 50, 1 in 100, 1 in 200, 1 in 400. The tests are read after one hour at room temperature.

The average titre of typhus fever serum is 1 in 200.

At first the two strains of bacilli were used and a cross-agglutination was observed. Later a mixed agglutinogen was used, and when this was employed positive agglutinations were obtained in more cases than positive complement-fixations. In 43 typhus cases (including the epidemic form), during some period of the disease, 39, or 90·7 per cent. were positive. Just as in complement-fixations, the agglutinations were usually absent at the height of the disease, increased in amount at the crisis, until they reached their maximum well on in the apyrexial period. They can be demonstrated at least five months after the crisis. Of 49 controls 7 showed agglutinins in dilutions of 1 in 20, but none in higher dilutions. These 7 cases consisted of the following: 1 was a brain tumour; 2, valvular heart defects; 2, general paralysis; 1, carcinoma of the tonsil; and 1 a case of alcoholism. In all complement-fixation was negative.

On this account Olitsky regards as positive only such cases as give agglutination in dilutions of 1 in 50 or higher. Agglutination with other than typhus organisms gave negative results in every case.

A considerable resemblance in the results was obtained in investigating precipitins to those obtained in the study of agglutinins and complement-fixation. No bacteriolysins were demonstrable. Opsonins are present. The index rises at the crisis and remains high in the convalescent stage of the disease. Olitsky considers that this method (opsonization) is one of the most potent, on the part of the patient, in overcoming the disease. He proved to his satisfaction by cross-fixation and cross-agglutination that the epidemic and endemic bacilli are merely two strains of the same organism. Experimental typhus in monkeys gives rise to serological changes in the same manner as in man. Of 6 monkeys that reacted to typhus virus, complement-fixation and agglutination tests were positive in 5, or 83·3 per cent. These reactions were still positive twenty days after the crisis. The average normal monkey has no such antibodies present. To produce these antibodies both in man and monkeys, large doses of antigen have to be given. In the case of guinea-pigs the result of inoculating the virus is quite different to that observed in the case of other animals. A guinea-pig injected with blood from a typhus patient on April 14, 1914, reacted on April 22. On June 16 it was again injected with a guinea-pig typhus virus. There was no reaction, hence the animal was proved to be immune. The animal was bled on July 7. Although the guinea-pig was proved immune, yet the serum contained no agglutinins or complement-fixing bodies. This experiment was repeated with other guinea-pigs.

Rabbits are not susceptible to the typhus bacillus in small doses. If given intravenously in large amounts they die in three to seven days.

The autopsy reveals no distinct pathological change. When small, yet increasing, doses of the bacilli are given, rabbits develop very potent immune serum, with especially high opsonic indices when compared with normal rabbits.

Observations made on the blood of two individuals proved very interesting. Both were definitely exposed to the typhus virus, one to

both types and one to the epidemic form only. At no time did either have any symptoms that could be recognized as typhus fever, yet they both developed complement-fixation bodies and agglutinins.

Previous work on the transmission of typhus had established the infectivity of typhus blood from man both for man and for animals.

The authors of this paper set out to ascertain whether the organism recovered from the blood of typhus patients was also found in the blood of animals inoculated with typhus blood. For this purpose, twenty-four guinea-pigs were inoculated with from 2·5 to 4 c.c. of defibrinated blood from patients with typhus fever diluted with an equal volume of normal salt solution.

Blood culture was made by cardiac puncture and grown in the usual media. A bacillus, morphologically and culturally identical with the one recovered from the blood of individuals with typhus fever, was recovered from the guinea-pig's blood in eight out of twenty-four, or in 33·3 per cent. They put down this low positive to the small amount of blood cultured—three cubic centimetres. The average number of colonies obtained from the eight positive bloods was three. This seems reasonable, as in man the positive results from fifteen cubic centimetres of blood produced only nine colonies in epidemic cases, and 2·06 in endemic cases. The febrile reaction at the time of the blood culture was proved to be due to typhus fever, as the blood of the guinea-pig which was the subject of the experiment was inoculated into other pigs, and all developed the disease after the usual incubation period of seven to fourteen days. They found that the best way of inoculating the guinea-pigs was by the intraperitoneal route.

Of eight guinea-pigs with positive blood cultures there was no doubt that the reaction was due to typhus, and in three guinea-pigs inoculated with blood which had given a negative result none developed the disease. Blood from six other animals with negative blood cultures was inoculated into thirteen guinea-pigs, and all developed the disease. This discrepancy with the blood culture may have been due to the small amount of blood used, as with human cases in which large quantities of blood were used no such discrepancy ever occurred.

Blood cultures were also made from four monkeys that had received an intraperitoneal inoculation of typhus virus. In one the blood culture was positive on the third day of the fever. The blood of this monkey produced the disease when inoculated into a guinea-pig. The relations between the blood culture and the severity of the disease can be noted both in animal experiments and in human cases; and is very suggestive that the bacillus is the cause of the disease. As to the relationship between the blood culture and the stage of the disease at which the blood is taken, it was found that the blood cultures taken twenty-four to seventy-two hours after the onset were positive in fifty per cent of animals. In the majority of the animals the fever reached its highest point on the second or third day. The finding of the bacilli in the blood of a guinea-pig twenty-four to thirty-six hours after the crisis was in accordance with the results of Nicolle and Conseil, and Anderson and Goldberger, who found the blood of a typhus case to be infective for animals twelve to thirty-two hours after the crisis.

It was found that the strains of the typhus bacillus when subcultured repeatedly, or when kept on artificial media for more than three or four

weeks, completely lose their virulence for animals. When inoculated into guinea-pigs only a transient rise of temperature was observed during the first twenty-four hours after the inoculation, apparently due to the action of the endotoxins.

This rise of temperature is completely done away with if the organisms are suspended for a half to one hour in a 1 in 20 to 1 in 100 dilution of typhus-immune serum.

On cultivation on artificial media for more than one month all strains lose this toxic action as well. In spite of repeated passage through mice and guinea-pigs it was found to be impossible to restore the virulence after it had once been lost.

Experiments on six strains of endemic typhus show that they lose their virulence more quickly than do strains from cases of the epidemic form of the disease.

At least two of the observations made in the preceding studies, i.e., (1) the fact that the organism is a bacillus, (2) and that it occurs in relatively small numbers in the blood, have a considerable bearing on the question of louse transmission. The presence of the few bacilli must render it relatively difficult for the lice to become infected, and this has been found by experiment. Lice only become infective five to six days after the first feeding, and the most probable explanation is one originally suggested by Wilder, that during this period the bacilli in the louse are undergoing an increase in numbers and virulence.

The authors also state that monkeys which have been exposed to the bites of infected lice may subsequently develop an immunity without having had fever or any other sign of the disease. This corresponds with the two cases mentioned before of individuals who developed agglutinins and complement-fixing antibodies after having been in contact with typhus cases without actually contracting the disease themselves.

From these experiments the authors have come to the following conclusions:—

(1) That a bacillus, identical with that recovered from patients with typhus, can also be isolated from the blood of animals in which the disease has been reproduced by the inoculation of typhus blood. In such animals the frequency of the bacillus in the blood is directly proportional to the severity of the disease. It is greatest at the height of the pyrexial period.

(2) That it is possible to produce the disease with the bacillus isolated from cases of typhus.

(3) That typhus blood is only infective if it contains a sufficient number of these bacilli.

H. G. G.

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Original Communications.

REPORT ON THE RESULTS OF THE BILHARZIA MISSION IN EGYPT, 1915.

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Royal Army Medical Corps.

Helminthologist to the London School of Tropical Medicine.

(*Continued from p.* 55.)

PART II: PREVENTION AND ERADICATION.

WATER IN RELATION TO THE SPREAD OF BILHARZIA.

WITH the knowledge that the infective agent of Bilharziosis is the cercaria, and that this can only develop in certain molluscan intermediaries, we have to consider whether anything can be done to control the spread of the disease. Professor Madden, who possesses, perhaps, the most intimate acquaintance of bilharziosis in all its clinical manifestations, wrote in 1910 that "among the Egyptian people generally there exists a widespread endemic disease, responsible for much suffering and a very considerable mortality among the agricultural population particularly, which we, as the controlling powers of the public health of the country, have done nothing to try and prevent." "Only those who are conversant with the habits and ways of the people are capable of judging of the apparent hopelessness of the task; but it is surely time that a beginning should be made with it, though along what lines it is not easy to indicate."

It was hoped by the authorities in Egypt that the preventive measures now being applied to ankylostomiasis would also prove efficacious in dealing with bilharziosis. These comprise free treatment, the introduction of conservancy, and the dissemination of knowledge of the disease amongst the natives. Such measures would appear, however, to be of little value in the control of bilharziosis, for the following reasons:—

(1) In ankylostomiasis treatment not only rapidly cures the individual patient, but by killing the adult parasites also assists in limiting the spread of the disease. In bilharziosis there is no recognized treatment other than merely palliative.

(2) In ankylostomiasis the disease is spread by the fæces only. In bilharziosis both urine and fæces would require control. The introduction of conservancy would not necessarily ensure the immunity of canals and the smaller streams of water from contamination with urine in agricultural districts.

(3) The co-operation of the natives in Egypt could only follow upon years of instruction resulting in a radical change in the habits of the people.

The remedy is to be sought elsewhere. Fortunately, there are certain physical conditions almost peculiar to Egypt which are inimical to the cercaria and its carrier, and which, if properly exploited, might bring about almost complete eradication of the disease in the course of a few years.

Water is absolutely essential for the life of the Bilharzia outside the body. In Egypt all water is derived from the Nile, directly by irrigation canals or indirectly by seepage into wells, and from rain.

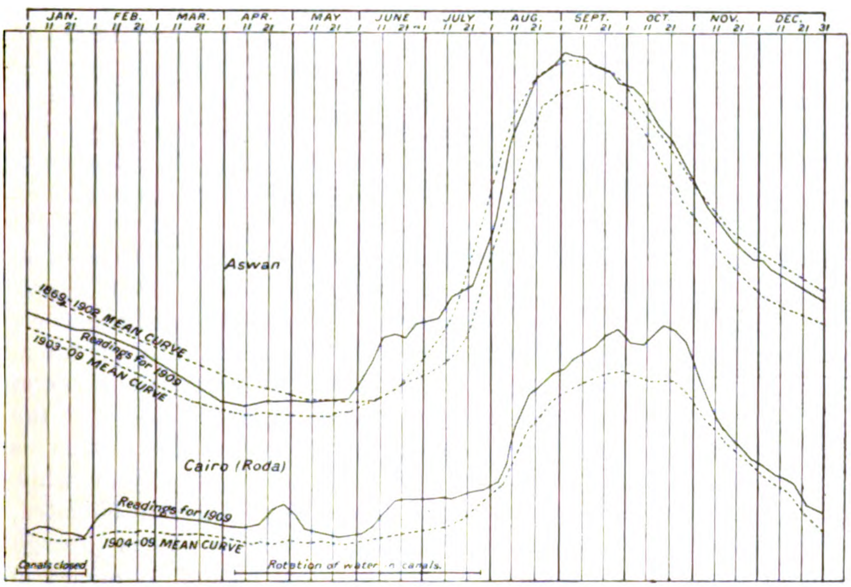


FIG. 23.—Showing annual rise in the Nile during the autumn.

THE NILE: IRRIGATION. Almost the whole of the water required for the cultivation of the land and for the use of the population is derived from the Nile. Until 1820 the cultivated land was irrigated by the Nile only during its annual rise. The land at the river's edge is ordinarily about nine metres above the river-bed. Every autumn the river rises from seven and a half to ten metres above its bed, as shown in the accompanying diagram (fig. 23). In the early days of Egyptian

history the Nile at these times inundated the whole of the valley. As the population increased, huge dykes were built parallel to the banks of the Nile, and from these other dykes were made stretching from the river to the hills to form large compartments or basins. During the flood the turbid waters of the river were led into these basins by artificial canals, and allowed to saturate the soil thoroughly and to deposit their rich mud on the surface. When each basin was properly irrigated, the water was allowed to pass on into other basins at a lower level, and eventually to return into the Nile when the flood had sufficiently receded to allow this.

According to Willcocks and Craig, this system of "basin" irrigation was in operation over the whole country through the times of the Pharaohs, Ptolemies, and Romans, down to the Arab Conquest in the seventh century. Between 700 A.D. and 1800 A.D. the dykes were uncared for and irrigation was abandoned over the greater part of the delta. The population gradually dwindled from 12,000,000 to 2,000,000. In 1821 Mohamed Ali changed the whole system by excavating a number of deep canals capable of drawing off the waters of the Nile at low level during the summer. This allowed of the cultivation of a summer crop and thus brought about the introduction of cotton upon a large scale. An area of over 3,100,000 acres is now perennially irrigated in Lower Egypt. In 1874, a quarter of a million acres in Upper Egypt and the whole of the Fayum were similarly converted from basin to perennial irrigation. The completion of the Assiut and Assouan barrages have been steps in the conversion of further large areas. At the present day the whole of Lower Egypt under cultivation is irrigated from canals which run throughout the whole year, while in Upper Egypt 964,000 acres are now also perennially irrigated, while 1,287,000 acres still receive their waters in basins through canals running only in flood. During a low flood the amount of water available is not sufficient to keep the whole area under cultivation. Those lands thus thrown out of cultivation are termed "Charaki" and are exempted from taxation (p. 151). With the extension of perennial irrigation the amount of "Charaki" is being continually diminished.

The extension of perennial irrigation has resulted in a marked increase in the prosperity of the people. The population has again risen to over 12 millions. At the same time, perennial irrigation appears to have encouraged the spread of bilharziosis. The disease is much more common at the present day in the Delta and in the Fayum than in those parts of Upper Egypt still supplied only with

RÉPARTITION PAR MOUDIRIEHS DES TERRES "CHARAKI," 1899-1912.

Années	Totaux	Assiout	Assouan	Beni Souef	Guerga	Gizeh	Kena	Minia	Béhéra	Dakahlieh	Gharbieh	Kalioubieh	Menoufieh
1899	352,213	35,075	34,508	10,342	75,813	38,258	135,567	17,492	1,284	204	87	690	2,893
1900	19,038	2,341	2,906	1,957	1,933	4,130	1,171	4,483	117	..	..	..	..
1901	12,845	1,231	1,618	1,455	1,215	4,000	726	2,132	438	..	..	..	..
1902	186,151	11,642	16,629	3,617	18,965	17,718	105,129	11,162	586	..	32	307	364
1903	5,158	611	2,164	426	524	224	322	887	..	..	..	..	..
1904	55,075	4,343	12,940	1,561	1,745	6,118	22,938	5,126	203	..	..	..	101
1905	47,147	4,190	10,397	1,811	2,634	6,177	15,855	5,683	213	..	..	..	187
1906	2,756	5	1,513	..	781	98	113	207	39	..	..	..	..
1907	124,671	6,994	15,947	1,776	16,229	10,185	65,139	8,181	170	..	..	..	50
1908	125	..	..	..	..	125	..	..	..	..	..	..	..
1911	377	11	16	83	..	17	5	235	10	..	..	..	..
1912	25,845	2,873	9,341	643	2,730	744	2,378	6,968	8	9	4	..	144

Ce sont les terres soumises au régime des bassins lesquelles, pendant les années de bas étiage, restent incultes faute d'eau et sont par conséquent exemptées de l'impôt foncier. La superficie de ces terres tend naturellement à diminuer avec l'extension du système de l'irrigation permanente. (From *Annuaire Statistique de l'Egypte*, 1914.)

basin irrigation. This has been remarked upon by Milton. In the Records of the Egyptian Government School of Medicine for 1904 he states:—

"Cairo is on the dividing line between Upper Egypt and the Delta, and patients come to Kasr-el-Ainy for treatment from all parts of the country; still the disproportion between the number of cases of bilharzia drawn from the two natural divisions of the country is so very marked that there must be some very well defined cause constantly acting, and this, I believe, is to be found in the way in which water is supplied to the different provinces for the purposes of irrigation. The provinces of Lower Egypt are supplied with water for irrigation all the year round, or practically so, whereas the Upper Provinces are supplied with water for irrigation only during and after the time of High Nile. Thus the peasant from Lower Egypt has a much longer period of time during which he is exposed to the chance of infection, and infection is more frequently repeated than is the case with his brother of the Upper Provinces.

"The province of Ghizeh is a case very much in point, for here, although it borders immediately on Cairo, and although Cairo is its hospital town, the proportion of its population per 100,000 coming for treatment for bilharzia is but 9·75 as compared to Sharkieh 19·85, Qalioubieh 18·06, and Menoufieh 13·47, the three other provinces adjoining the capital, but then Ghizeh is basin irrigated, whereas the other provinces named are perennially irrigated."

The relative frequency of bilharziosis in perennially irrigated areas may be due in part to continued liability of the workers to infection as suggested by Milton, but the favourable environment created for the propagation of the intermediate host is probably a much more important factor.

The Nile: Subsoil Water. Subsoil water is generally derived from local rainfall, but in Lower Egypt it is practically all the result of seepage from the Nile and its canals. The average thickness of the Nile alluvium is said to be about seven metres, below this is a layer of sand and gravel into which the river-bed dips. Through this layer, when the river is in flood, a natural flow of water takes place and the static head of the river in flood is thus transmitted to great distances, causing a rise in the level of the subsoil water. This rise is sometimes actually visible, for low-lying land near the river may become covered with water. The subsoil water of the deep sand and gravel strata is utilized for the water supply of towns and for purposes

of irrigation in Upper and Middle Egypt and in the southern half of the Delta. In the fields it is not an uncommon sight to see the water being lifted from deep wells by means of Persian wheels or "sakias," as they are termed in Egypt, driven by one or two blindfolded animals: usually buffaloes, but sometimes camels and bullocks (fig. 24). The "sakia" consists of a vertical wheel carrying an endless rope, slung with earthen pots or buckets which dip into

FIG. 24.—A "sakia" in use in the fields near Marg.

the water. On its axle is a rough wooden-cogged wheel actuated by another cog-wheel placed horizontally. This wheel is moved by a pole fixed at one end to the axle and at the other to the neck of the animal being used to turn it.

According to Mr. Crawley there are five thousand two hundred and fifty-five "sakias," and two thousand two hundred and ninety wells with engines and pumps, drawing subsoil water in fields in the Lower Egypt Irrigation Inspectorate.

Rainfall. The rainfall in Egypt is at no time enough of itself to moisten the soil sufficiently for agricultural use, and is confined to the winter months from October to April. As will be seen from the accompanying table, no rain was recorded from any part of Egypt during the months of June, July, August, and September. Mr. Hurst, of the Physical Science Department of Egypt, has examined the official records for the last twenty years, and has found that an absence of rain during these months has been constant.

Monthly Rainfall in Millimetres during 1912.

Station	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Alexandria (Mex)	14	26	7	0	0	0	0	0	0	Drops	1	26
Port Said ..	23	58	8	0	6	0	0	0	0	Drops	Drops	9
Suez	Drops	1	0	0	0	0	0	0	0	0	0	4
Ismailia ..	10	6	6	Drops	0	0	0	0	0	Drops	0	6
Cairo, Ezbekia..	3	9	Drops	Drops	0	0	0	0	0	Drops	0	5
Giza ..	4	9	Drops	Drops	0	0	0	0	0	Drops	0	2
Abbassia..	0	7	0	0	0	0	0	0	0	Drops	0	3
Kafr el Zayât ..	9	19	Drops	0	4	0	0	0	0	6	1	9
Tanta ..	10	17	2	0	3	0	0	0	0	1	Drops	10
Kafr el Dawar..	28	58	6	Drops	2	0	0	0	0	1	1	40
Damanhur ..	15	28	7	Drops	3	0	0	0	0	1	Drops	23
Shebim el Kom	2	14	Drops	0	2	0	0	0	0	0	0	4
Damietta ..	67	30	10	Drops	7	0	0	0	0	16	3	17
Manzala ..	13	20	4	Drops	Drops	0	0	0	0	Drops	0	Drops

The average rainfall per annum at Cairo during the last nineteen years is only 3·28 centimetres. Willcocks and Craig estimate that the amount of the Nile water used on the Delta to irrigate the crops corresponds approximately to a rainfall of 1·30 metres, i.e., fifty-one inches per annum.

Protective Measures.

The life of the bilharzia outside the body may be divided into three periods: (1) That between the passage of the egg into water and the entrance of the hatched parasite into the mollusc; (2) the stage of metamorphosis within the mollusc; (3) that prior to the entrance of the free-swimming cercaria into the human body after it has left the mollusc. It is universally recognized that in Egypt under present circumstances it is practically impossible to prevent the contamination of water with infected urine and fæces. In order to break the life-cycle of the bilharzia worm one must find some simple means of destroying it during the free-swimming infective stage, or of depriving it of its essential intermediate host.

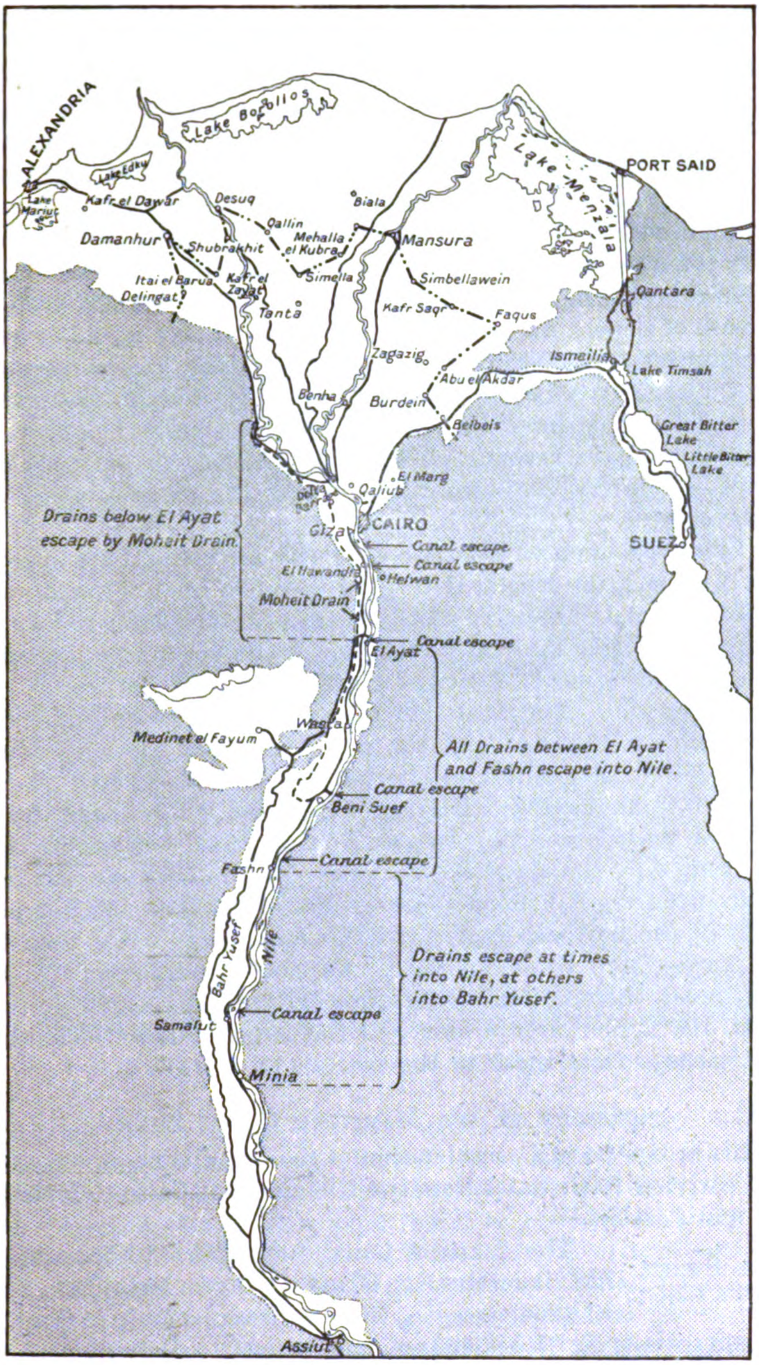
The former is the line of attack suited to the conditions under which bilharziosis is acquired in large towns; the latter is applicable to country villages and districts.

Prevention of Bilharziosis in Towns.

It has been shown earlier in the report that bilharziosis is frequently contracted by young children in the city of Cairo. The infection could have been derived only from the public water supply, and it was suggested that the unfiltered water supplied throughout Cairo by pipes for garden and stable purposes was the most likely source. This water is pumped from the Nile where infections are known to have been contracted. It has been our experience that very few gastropod molluscs could be found on the banks of the Nile in the neighbourhood of Cairo. It is obvious, therefore, that preventive measures applicable to Cairo and similarly situated large towns should be directed to the destruction of the cercaria in the water taken from the Nile. The ideal, of course, would be to do away with the unfiltered supply entirely. It is said, however, that such a course would deprive Cairo of its gardens and would meet with tremendous opposition. As this unfiltered water must be a continual source of grave risk to the public health from other and more virulent diseases than bilharziosis, it is evident that such opposition must have been both strenuous and triumphant when this system of dual supply is still tolerated by the authorities. Numerous experiments were made to determine if infected water could be rapidly sterilized. The results of this inquiry will be detailed later in connection with the supply of safe water to small bodies of men. They were entirely inapplicable to the requirements of Cairo. There is, however, one feature about the bilharzia cercaria which may be used possibly to conserve the unfiltered water supply; that is the brief duration of life of the free-swimming cercaria. It has been found impossible to keep the cercaria alive for more than thirty-six hours. If it were practicable to store Cairo's daily requirement of unfiltered water for two days or a day and a half, there is no doubt that it would become practically free from danger as far as bilharziosis is concerned. It may be noted, however, that it would at the same time lose that heavy sediment which has a distinct manurial value. Against this loss may be set the fact that, under the present system, one-third of the thirty thousand children born annually in Cairo become infected with bilharzia.

ORIGIN OF BILHARZIA INFECTION IN CAIRO. The source of infection of the Nile water at Cairo is somewhat difficult to locate. Under the miracidium infection theory it was attributed to contamination of the water by infected urine from the crews on the boats which daily congregate near the Kasr Nil bridge. On the alternative hypothesis of a molluscan intermediary one must look farther afield. The molluscs known to harbour bilharzia cercaria congregate mostly in the smaller canals and ditches where there is a good deal of vegetable substance for food. They are air-breathers and require to seek the surface from time to time. In the Delta, water does not return to the Nile when once it has been used for irrigation purposes. The whole of the agricultural drainage water is discharged either into the salt lakes near the Mediterranean shore or directly into the sea. That of the valley or "Wadi Tumilat" which runs from Zagazig to Ismailia discharges into Lake Timsah on the Suez Canal. In Upper Egypt, however, the canals have escapes at various points on their courses which allow surplus water to return into the Nile. The agricultural drains also discharge into the Nile at certain places. These escapes are indicated on the accompanying map (fig. 25). It will be seen that from Minia to Fashn the drainage is turned sometimes into the Nile, and at other times into the Bahr Yusef, whence it makes its way through the Fayum into Lake Kurun or continues to discharge at El Ayat by the Giza Canal escape. Between Fashn and El Ayat all drains escape into the Nile, while below El Ayat the drains discharge into the large Moheit drain which enters the Rayah el Behera below the Barrage north of Cairo. A few miles south of Cairo it will be noticed that the Giza Canal has two escapes into the Nile.

EFFECT OF VARYING VELOCITIES OF THE NILE. The velocity of the Nile varies from month to month. Whereas the movement of water down the Nile from the Assiut Barrage to the Delta Barrage occupies seven days in a mean year during March to August, in September the water travels the same distance in three days, in October and November it takes four days, while from December to February five days are necessary. Taking one and a half days as the approximate duration of life of the free-swimming cercaria, it is evident that at all times of the year water freshly contaminated with cercaria at Assiut would become safe long before it reached Cairo. During high flood in September the Nile has a velocity of about one hundred and fifty kilometres per diem, that is water containing freshly discharged cercaria entering the Nile within about one hundred and fifty miles up-stream of Cairo would



ALEXANDRIA
Lake Borollos
Lake Edku
Lake Mariut
Kafr el Dawar
Desuq
Biala
PORT SAID
Lake Menzala
Damanhur
Shubrakhit
Qallin
Mehalla el Kubra
Mansura
Simella
Simbellawein
Itai el Barud
Kafr el Zayat
Tanta
Delingat
Kafr Saqr
Faqus
Qantara
Zagazig
Ismailia
Lake Timsah
Abu el Akdar
Burdein
Benha
Belbeis
Great Bitter Lake
Little Bitter Lake
El Marg
Qaliub
CAIRO
Giza
Drains below El Ayat escape by Moheit Drain
Canal escape
Canal escape
El Hawandia
Helwan
SUEZ
Moheit Drain
Canal escape
El Ayat
Medinet el Fayum
Wasta
All Drains between El Ayat and Fashn escape into Nile.
Canal escape
Beni Suef
Fashn
Canal escape
Bahr Yusef
Nile
Drains escape at times into Nile, at others into Bahr Yusef.
Samalut
Canal escape
Minia
Assiut

FIG. 25.

still be infective when passing the city. Minia is a little more than this distance from Cairo, so that all the drainage water which, as we have seen, discharges into the Nile between Minia and El Ayat would still be infective at Cairo during the time of high Nile. During the summer months when the Nile is at low stage the maximum velocity at Wasta (see fig. 25) varies between thirty and thirty-three kilometres per diem, according to Craig. Farther down stream this will be less as the Delta Barrage is reached, owing to decrease of slope. About thirty kilometres per day would be a fair average over this reach. According to this, active cercaria would only travel thirty miles in a day and a half, so that infected water entering the Nile more than thirty miles up-stream, i.e., above El Ayat, should have become innocuous by the time it reached Cairo except in so far as occasional infected molluscs may be carried down by the current.

If the facts upon which these conclusions are based are approximately correct, the Nile at Cairo, and therefore the unfiltered water supply, should be infective chiefly during the autumn; the source of infection during the rest of the year being apparently limited to the escapes between El Ayat and Cairo.

VELOCITIES OF THE CANALS IN THE DELTA. Down stream from Cairo, water only re-enters the Nile and the main canals by seepage. From September to December water takes 1·6 to 1·9 days to travel from the Delta Barrage to the sea. From January to April the period gradually lessens from 2·1 to 2·6 days; in May, June and July 2·8 days are occupied. From this we conclude that even during Nile flood the branches of the Nile and the main canals in the northern half of the Delta are less liable than the Nile above Cairo to be infective. The bulk of infections in the Delta must therefore originate directly from the small tertiary canals, the agricultural drains and the large drains which carry the discharge from these to the sea.

INFECTION IN THE MARITIME CANAL ZONE.

This brings us to a consideration of the Ismailia or sweet water canal carrying fresh water from the Nile north of Cairo to Ismailia, Suez and Port Said.

THE SWEET WATER CANAL. The Ismailia Canal from Cairo to Ismailia is 128 kilometres, i.e., 80 miles. From Ismailia to Suez 90 kilometres, i.e., 56 miles, from Ismailia to Qantara it is approximately 34 kilometres, and thence to Port Said about 43 kilometres The maximum velocity on the Ismailia Canal is near

the head, about 42 kilometres per day, which probably falls somewhat lower down. On the Suez portion of the fresh-water canal at 40 kilometres from Ismailia, the velocity, according to Mr. Hall, is 0·27 metre per second—i.e., less than 24 kilometres, or 15 miles, per twenty-four hours.

Mr. Craig, of the Statistical Department, writes, that the time of flow from the Barrage to Ismailia may be taken as two days, and that this rate does not vary much from low stage to high stage

FIG. 26.—The Port Said branch of the sweet water canal at Qantara.

of the river. From this one may conclude: (*a*) that any infection entering the canal at its head, even during high flood, would have died out before it reached Ismailia; (*b*) any bilharzia infections acquired in the Canal zone from the Port Said and Suez branches of the canal must originate from local infection of molluscs in the Ismailia Canal. In the stretch from Cairo to Ismailia the canal is very free from vegetation, and molluscs are relatively very rare. From Ismailia to Qantara, and from Ismailia to Suez, the amount of weed is so great that it is difficult to traverse these sections

by motor launch. Among the weed, specimens of Bullinus are common. We did not succeed in finding infected forms. These two canal branches are the sole sources of supply of fresh water to Port Said and Suez. They are open to contamination with bilharzia: (1) from villages upon the banks; (2) from the pathways running the whole course of the canal; and (3) from shipping. The water appears to be infective only to a relatively small degree, because the children in the schools of Suez and Port Said show a

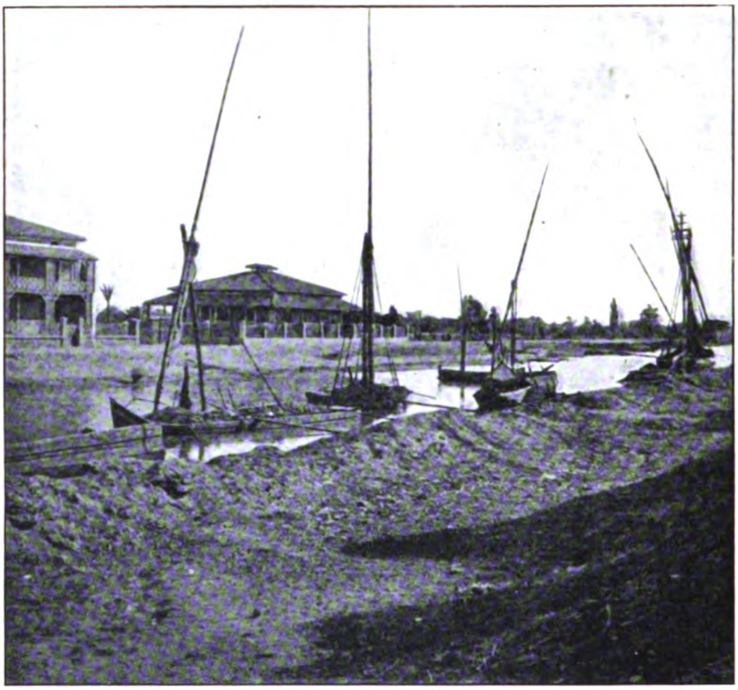


FIG. 27.—The sweet water canal outside Ismailia.

low percentage of cases. At Suez, one child out of nineteen in a school on the outskirts of the town was infected. At Port Said, according to Dr. Orme, bilharzia eggs were found in the urine of five out of forty healthy pupils in the Government school. At Ismailia, unfiltered water taken from the canal on the outskirts of the town is supplied to the European houses and is actually laid on as the cold water supply in the bathrooms. Had the canal water been commonly infected a considerable number of cases of bilharziosis should have been recorded among the European inhabitants.

The Port Said section of the fresh-water canal is not being used by boats and is only open to infection at the present time from those using the footpath along its bank. If this path were diverted the risk of infection should become negligible after some months. On the southern section from Ismailia to Suez a number of villages have arisen on both banks. Paths follow both banks. The canal is used regularly by small boats making forty to one hundred

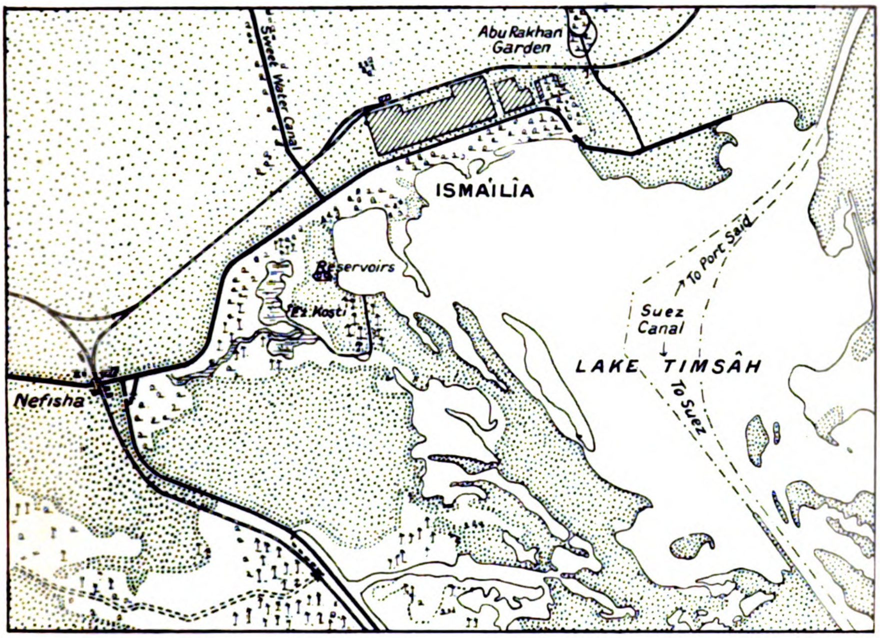


Fig. 28.—The relations of the Sweet Water Canal and its branches to the town of Ismailia.

journeys per month in each direction. From this canal water is led at intervals by small channels to the posts on the maritime canal. It appears impossible to insure under present circumstances that the water reaching these posts should be free from infection.

Marshes. Local practitioners state that there is a fair amount of bilharzia amongst the native population of Ismailia. This is most probably acquired in the low-lying fields and marshes to the south-west of the town, and from the Taftish el Wady drain, which carries off the whole of the drainage of the Wady Tumilat, between Tel el Kebir and Ismailia, and ultimately debouches into Lake Timsah. Specimens

of *Planorbis boissyi* were common in the marshes and ditches there and were found harbouring developmental stages of bilharzia type.

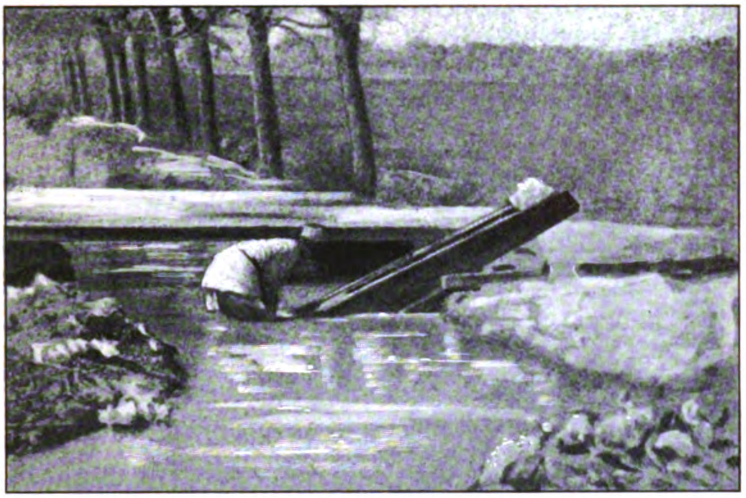
Marshes, which usually occupy low-lying areas and derive their water in part from seepage, can only be dealt with adequately by filling. The value of the land reclaimed should compensate for this necessary outlay. Moreover, these marshes are the main breeding-places of malaria-bearing mosquitoes, and on this account

FIG. 29.—Filling marsh at Ismailia.

alone their abolition is called for even at some cost to the State, as shown in the accompanying photograph (fig. 29). The marshes near Ismailia which were found to be a possible source of danger on account of bilharziosis are being rapidly filled in as an anti-malaria measure in completion of Sir Ronald Ross' recommendations for the protection of Ismailia.

PREVENTION OF BILHARZIOSIS IN AGRICULTURAL DISTRICTS.

Whereas the essential condition to the prevention of bilharziosis in towns was found to be the destruction of the free-swimming



(From "A Textbook of Egyptian Agriculture.")

Fig. 30.—The wooden trough, "badala" or "waboor," for lifting water from twenty-five to fifty centimetres, in use.

(From "A Textbook of Egyptian Agriculture.")

Fig. 31.—The "nattala," a closely plaited straw basket with four cords, for lifting water about one metre.

cercaria, in country districts water in small canals, shallow ditches and irrigated fields is so general and there are certain agricultural appliances (such as those illustrated in fig. 30 and fig. 31) which necessitate continual exposure to infected water in such common use that other preventive measures must be found.

FIG. 32.—Iron pipe in the course of the Marg Canal regulating amount of flow.

GOVERNMENT CONTROL OF NILE WATER.

In those areas enjoying the privileges of perennial irrigation the water is not allowed to run indiscriminately. The supply is carefully husbanded and is entirely under the control and constant supervision of the Irrigation Department. The irrigation outlets from the public canals are furnished with iron pipes of a definite diameter so that the amount of water passing shall bear a calculated relation to the area served (fig. 32).

During the summer months the water in the canals is controlled by the periodical closure of the head regulators for definite periods. These times are officially announced by the Government. A copy

of the announcement for the earlier part of the summer of 1915 is reproduced on the page opposite. It will be seen that after running for a period of six days the water was shut off for fifteen days. This system of "rotation" was enforced at the beginning of April and was maintained until the Nile flood (as shown in fig. 23) reached the Delta early in August.

Under the Canal Act of 1894 severe penalties are imposed upon those attempting to interfere in any way with the working of the irrigation system. Imprisonment for periods up to two months and fines not exceeding £20 may be imposed in cases of infraction or disregard of the law.

With the increase in the amount of water available which has followed upon the building of the various dams and reservoirs, new lands more remote from the Nile have annually been brought under cultivation.

Suggestions for Eradication.

If some simple means could be found of stamping out the molluscs in those situations in which the molluscs harbouring bilharzia congregate and multiply not only would the incidence of the disease be greatly reduced in the country, but the liability to infection would also be greatly diminished in the large towns, e.g., Bilbeis, on the main drains into which the small drainage ditches discharge. The following proposals are based upon a study of the problem in the district of which Marg is the centre. The method, which seems applicable to other parts of Lower Egypt, save, perhaps, those in which rice is the chief crop during the summer months, utilizes the present "rotations" in the supply of water enforced by the Government from April until August. During periodical stoppages of fifteen days the El Marg Canal became dry except for occasional puddles (figs. 11, 12, 33, 34, 35). The molluscs were either stranded upon the drying mud or collected in these puddles. It was found that several days before the return of the water the Planorbis and Bullinus taken from the dry bottom did not revive when placed in water. Those in the small puddles of water had been able to survive, the Planorbis being apparently more hardy than the Bullinus. Had any attention been given to the alignment of the Marg Canal so that small collections of residual water could not provide a "carry-over" for the molluscs, these would have been killed automatically by the "rotation" alone, just at the commencement of their annual reproductive activity. The same

Drying.

[*Copy.*]

MINISTRY OF PUBLIC WORKS.

IRRIGATION DEPARTMENT—FIRST CIRCLE.

PROGRAMME OF SUMMER ROTATIONS, 1915, IN QALIUBIA, SHARQIA, AND DAQAHLIA PROVINCES.

Canals on Cotton Rotations.

The following are the sections into which the various canals are divided for rotation purposes :—

Names of Canals	Limits of Sections					
	Section A		Section B		Section C	
	From	To	From	To	From	To
Isma'ilia branches	Head	Qaliubia boundary	—	—	—	—
Sharqawia	Head	Khalili Head	—	—	—	—
Sissa	,,	Tail	—	—	—	—
Marsafawia	,,	,,	—	—	—	—
Qenneba and branches	,,	,,	—	—	—	—
Khalili and branches..	—	—	Head	Tail	—	—
Zefeita and branches..	—	—	—	—	Head	Tail
Shebini and branches	—	—	—	—	,,	,,

SUMMER ROTATIONS (1915) IN LOWER EGYPT.

Summer Rotations, in accordance with the lists already published for each Circle of Irrigation, will be imposed throughout Lower Egypt as per the time-tables given below :—

Canals on Cotton Rotations.

	Period		Sections		
	From	To	*A*	*B*	*C*
	April 8	April 13	Stopping	Working	Stopping
	,, 14	,, 19	Stopping	Stopping	Working
	April 20		General stopping		
21 days	April 21	April 26	Working	Stopping	Stopping
	April 27		General stopping		
	April 28	May 3	Stopping	Working	Stopping
	May 4		General stopping		
	May 5	May 10	Stopping	Stopping	Working
	May 11		General stopping		
21 days	May 12	May 17	Working	Stopping	Stopping
	May 18		General stopping		
	May 19	May 24	Stopping	Working	Stopping
	May 25		General stopping		
	May 26	May 31	Stopping	Stopping	Working

REMARKS.

(1) *Sifi* channels not specifically named in this list will be on the same rotation as the parent channel from which they derive their supply.

(2) The working turn, or period over which irrigation is allowed, begins at sunrise of the first day of the period and ends at sunrise of the day following the last day of the period.

(3) During the working turn of any section, water will be supplied, to the extent that the available supply of water may permit, to all public and private canals and outlets lying within the limits of that section, as described in the programme.

(4) The heads of all private canals and all outlets must be punctually closed and all lifting machines must cease to work at the expiration of the working turn.

(5) By Article 32 (30) of the Canal Act, 1894, it is enacted :—

> "Whoever takes water from a canal, whether by opening the head of the canal, or of the water-course, or by cutting banks, or by lifting the water artificially during the days that the Inspector of Irrigation or any other authority duly authorized shall have made known that water from the canal must not be used for irrigation, will be punished by imprisonment for a period of from fifteen days to two months, and a fine not exceeding L.E.20.

(6) The prescriptions of Article 32 (30) of the Canal Act will be strictly enforced, and the Irrigation Service will take such further administrative measures in case of infraction or disregard of the Law as the nature of the case may require.

(7) The breakdown of a lifting machine gives no right to compensation-supply out of turn.

object might be attained by the provision of an alternative route for the "rotation" water from the secondary canal to the fields.

CHEMICAL AGENTS.

The small collections of residual water might be treated chemically so as to destroy the surviving molluscs. As the water so treated would be carried on to the land at the commencement of the following "rotation" it would be essential that the chemical used should not be injurious

FIG. 33.—The bed of the Marg Canal in the village during a summer rotation.

to the crops. Certain chemicals are used nowadays on a large scale as manures. It was found experimentally that some of these, especially ammonium sulphate, in weak solution killed the molluscs within a few hours. This chemical manure can therefore be used with safety, and *without ultimate loss*, to kill off those molluscs which had escaped destruction by drying.

CLOSED DRAINS.

The small drains, such as that figured on page 39, are less cared for, as a rule, than the small supply canals. They consequently become over-grown

with weeds, which frequently afford sufficient protection to the molluscs to enable them to survive for a considerable period. In Egypt, drainage is always effected by means of open drains. The periodical clearing of these drains must, therefore, be regarded as an essential part of any scheme for the eradication of bilharziosis until the open drain can be abolished.

The English system of field drainage by underground pipes has scarcely received proper trial in Egypt. Quite recently the State Domains Administration made some experiments on the washing of salted land by filtration into drain pipes and this method was found to be better than that of filtration into open drains. The cost, however, proved out of proportion to the extra benefit from the agriculturists' point of view.

Although the initial cost may seem considerable, it should not be overlooked that there would be a distinct saving in other directions. The annual charges for clearing the open drains would be abolished, there would be no heavy losses or damage through the falling of live stock into the drains, and the land recovered would represent a considerable increment of capital.

Lang-Anderson has estimated that if pipes could be obtained in Egypt at about the same cost as prevails in England, the conversion of an open drain 300 metres in length into a covered drain would involve an outlay of a little over £3. About 1,200 square metres of land previously occupied by the open drain would then be available for agricultural purposes. Valued at £42 per feddan, this recovered land would be worth £12.

The mole drain plough is said to be an efficient and very cheap method of drainage. Lang-Anderson believes that the soil of Egypt would give a satisfactory bore to this machine. If this proved to be the case earthenware pipes could be dispensed with.

CANAL CLEARANCES.

The canals are closed annually for a period of a month, usually from December 25 to January 25, to allow of the removal of silt. If it were practicable to carry out these canal clearances at the commencement of the summer in conjunction with the rotations of water, the work should greatly assist in the elimination of the fresh-water molluscs.

A SUMMER CAMPAIGN.

As the anti-bilharziosis measures proposed depend for their success upon the summer rotations, the campaign would be confined to the months from April to August. We now proceed to acquaint ourselves with the agricultural activities in perennially irrigated land during these months, to see to what extent these would assist or

FIG. 34.—Marg Canal as it enters the village, a few days after the water has been cut off in the "rotations."

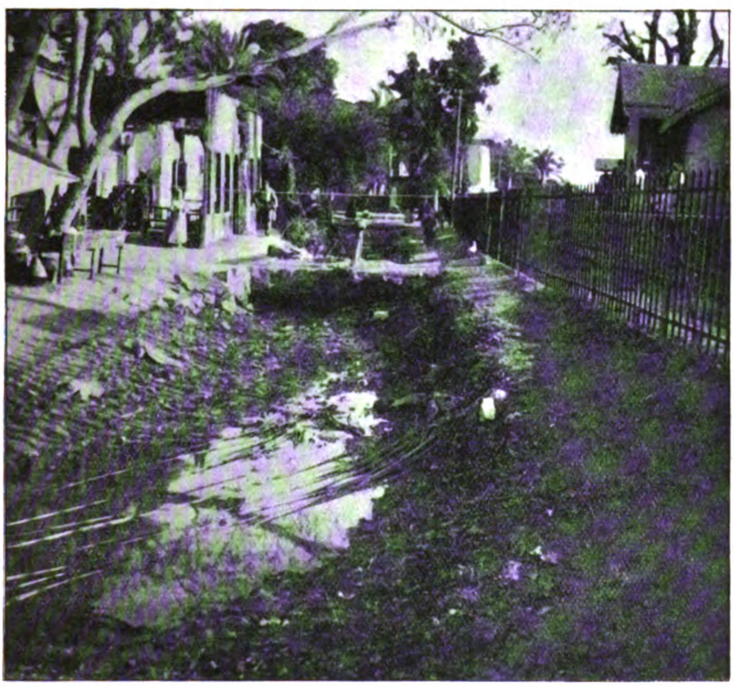


FIG. 35.—Marg Canal passing the railway station, same view as in fig. 5, but during the "rotations."

interfere with the steps proposed. The main crops in Egypt are cotton, wheat, clover, and maize. Wheat and clover are winter and spring crops, and are harvested by May. Cotton occupies the land from April until October. Maize is a "catch" crop, sown late in July and harvested in October. Apparently the chief crop under cultivation during June and July is cotton. Cotton is not grown annually. On the best land it can be grown every alternate summer, but it is usually planted once in three years on the same land.

Dates of Sowing and Harvesting in Lower Egypt.

Sowing.		*Harvesting.*	
March to April ..	Cotton. Lucerne. Earthnuts. Henna. Onions. Summer melons. Sugar-cane.	March to April ..	Flax.
		April	Fenugreek and lupins.
		April to May ..	Barley.
May to June ..	Summer rice.	May	Wheat.
		June	Seed berseem.
June to July ..	Sesame.	July	Onions.
July to August ..	Flood melons. Maize. Millet. Flood rice.	July to August ..	Summer melons.
Sept. to Nov. ..	Berseem (clover).	Sept. to Nov. ..	Summer rice. Dates—cotton.
		Sept. to Dec. ..	Henna.
Oct. to Nov. ..	Lupins. Flax.	Oct. to Nov. ..	Maize. Sesame. Melons.
Nov. to Dec. ..	Wheat. Barley. Beans.	Nov. to Dec. ..	Maize. Millet. Earthnuts.
		Nov. to March ..	Sugar-cane.
		Nov. to May ..	Green berseem.

On the simple three years' rotation usual in Egypt the land is divided into three parts, and placed under wheat, clover, and cotton. Wheat and clover being winter crops are harvested before June, and the land is left in bare fallow until the following February, unless a catch crop of maize is interposed at the beginning of August. We see from this that at the present time two-thirds of the land is annually in bare fallow during June and July, while the remaining third is under cotton.

Turning now to fig. 36, it will be observed that May, June and July are the months in which humidity reaches its lowest point, and the temperature attains its maximum, consequently evaporation is most rapid at this time. The climatic and agricultural conditions in Egypt are therefore most favourable for a campaign against the

Average	First Year		Second Year		Third Year	
	Winter	Summer	Winter	Summer	Winter	Summer
One-third	Wheat	Bare fallow or Maize ("Catch" crop	Clover ("Catch" crop)	Cotton	Clover	Bare fallow or Maize ("Catch" crop)
One-third	Clover		Wheat	Bare fallow or Maize ("Catch" crop)	Clover ("Catch" crop)	Cotton
One-third	Clover ("Catch" crop)	Cotton	Clover		Wheat	Bare fallow or Maize ("Catch" crop)

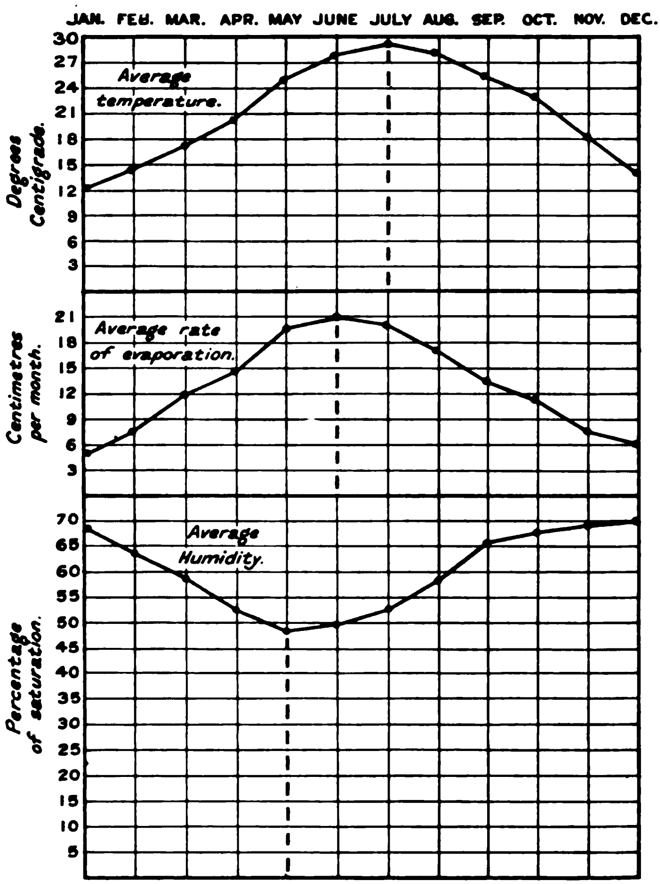


FIG. 36.—Monthly average temperature, humidity and evaporation.

molluscan carriers of Bilharzia during June and July. Taking tertiary canals as supply units, it should be possible by adjusting the rotation of crops so to group the land under cotton that, in a given area, a third only of the tertiary canals need be used during these months. The tertiary canals and drains supplying the other two-thirds of the land would become thoroughly desiccated, and their molluscan fauna completely destroyed.

If the additional precaution of screening the tertiary canal head were taken, the diminished supply involved by the mesh should be compensated for by the insertion of a second screened pipe rather than by the replacement of the original pipe by one of larger bore. The screens would require periodical cleaning and supervision throughout the year.

UTILIZING LEAN YEARS.

The table of charaki lands given on p. 151 shows in feddans that a large area, varying from year to year, is thrown out of cultivation when there is a shortage of Nile water during the summer. Further, the Government, under circumstances like those operating during the present War, takes steps to restrict the area placed under cotton. Whenever the land is brought into bare fallow from such causes, efforts should be made as far as possible so to group the incidence of fallow and cotton fields in a given area that the transient financial loss directly contributes to a diminution in the amount of Bilharziosis in the district penalized.

BILHARZIOSIS CAMPAIGN AND COTTON WORM.

The proposal to render cultivated land as dry and hot as possible during the whole of June and July as a means of attacking the bilharzia-carrying molluscs would be very beneficial for the cotton fields themselves. The prominence of Egyptian cotton in the world's market is based upon its quality alone, and it has been shown that considerable deterioration follows a too copious supply of water. Moreover, when green and well-irrigated fields of clover are interspersed between the cotton fields during June, the cotton worms are provided with plenty of food and shade until the young cotton plants have produced sufficient foliage to receive them. If, on the other hand, the cotton fields can be kept dry, and the plants consequently hard and fibrous, millions of the cotton worms would perish.

ROADS AND SHIPPING.

The contamination of the water with infected urine and fæces must continue so long as the river and main canals are the chief vehicle for transport in Egypt. There are still few main roads, and these generally

occupy the banks of canals and main drains which are entirely open to pollution. At the present day, as in the time of Herodotus, "The Egyptians perform publicly those natural functions which it is the custom for members of other races to carry out in private." In the new areas now being reclaimed, it should be possible to provide more adequate protection for the main watercourses.

The replacement of the small agricultural drains by piping or by "mole" drains, together with the proper utilization of canal clearances and the periodical drying of the small canals during the summer "rotations," should prove successful in controlling bilharzia, even although the molluscan intermediaries were not entirely destroyed. The molluscs are slow in growth and propagation as compared with other animal carriers of human diseases. Re-stocking with half-grown or adult forms might be prevented if it proved practicable to screen the iron pipe regulating the flow of a tertiary canal at its head.

Concerning Reclamation.

At the beginning of the nineteenth century, owing to neglect, the cultivated area of the Delta had shrunk to that portion lying between Cairo and an irregular line (shown on fig. 25) passing through Delingat, Damanhur, Itai el Barua, Shubrakhit, Desuq, Qallin, Simella, Mansura, Faqus, Burdein, and Bilbeis. The introduction of perennial irrigation brought about a rapid increase in the population of Egypt, which was met by an extension of the area brought under irrigation. This increase still continues and is greatest where irrigation projects are most active. During the ten years ending 1907 the population, according to Willcocks, had increased sixteen per cent, while the cultivated area increased only thirteen per cent. It is clear, therefore, that new land must be brought continually under cultivation to meet the increasing needs. The total acreage of Lower Egypt is 5,190,000 acres. Of this, 3,100,000 acres are now cultivated land, 1,190,000 acres are waste land ("Berea"), or ordinarily too salted to produce crops without reclamation; 600,000 acres are covered by lakes. The whole of the Berea or waste land was cultivated in the Ptolemaic and Roman era. According to local tradition some of these waste tracts now bordering the lakes were once covered with vineyards or divided into enormous basins planted with wheat. The numberless mounds strewn with bricks and pottery which nowadays arise from these extensive barren plains are evidence that they once supported a dense population.

As we have seen (p. 150) the extension of perennial irrigation in the past has been accompanied by a similar extension of bilharzia infection. The bilharzia-carrying fresh-water molluscs cannot live in saltish water. Every effort should be made, therefore, in the future reclamation of the salted lands in the north of the Delta to ensure, as far as possible, that favourable conditions are not created at the same time for their colonization by the bilharzia-spreading molluscs.

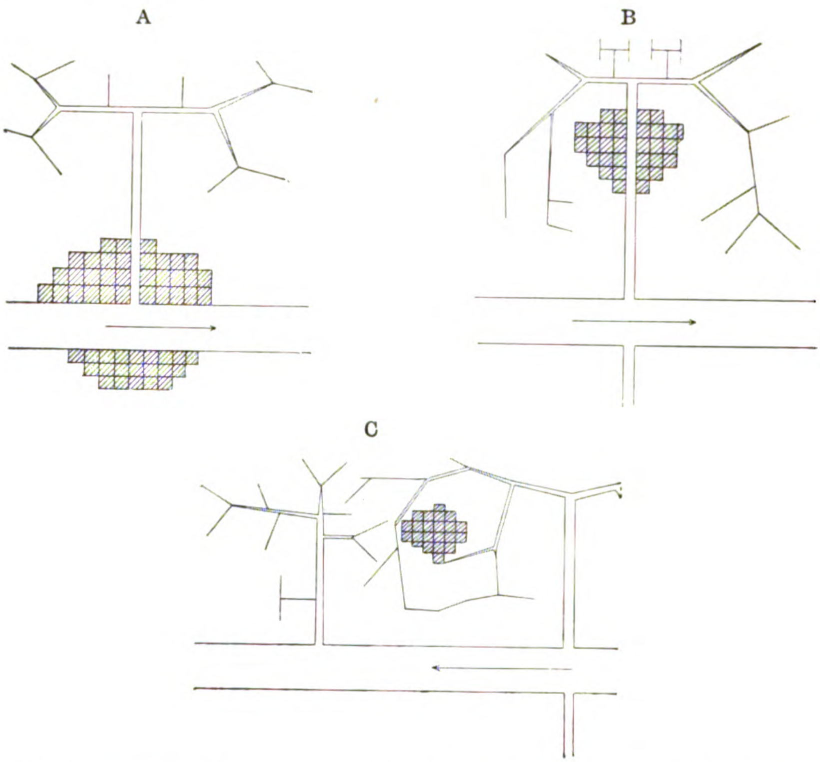


FIG. 37.—The relations of villages to the canals. A, village on either bank of a main or secondary canal; B, village on a tertiary canal; C, village between two tertiary canals.

(1) If the banks of main canals or drains are used as roads the water should be adequately protected from contamination. If possible, however, the roads should run between the terminations of two systems of tertiary drains.

(2) Villages should not be made on the main drains or on the primary or secondary canals. They should be located as far as

possible between two tertiary canals. A glance at fig. 37, A shows at once that where a village is on the bank of a main or secondary canal the bilharzia eggs and embryos carried on in the main stream passing through the village are liable to infect all the tertiary canals supplied from the canal in the section down stream of the village. This arrangement one sees frequently on the Suez section of the sweet water canal. Where the village is on a tertiary canal (fig. 37, B) as happens at El Marg, the water passing through the village is dissipated on the surrounding fields so that the area of infectivity of the village is limited practically by its own communal boundaries. Where a village lies between two tertiary canals, as in fig. 37, C, the liability to contamination of the water channels is practically restricted to those paths leading from the village and such branches as are used for washing and other domestic purposes.

(3) The village water supply should be derived from "sakias" or deeper wells. Each irrigation unit should possess paired supply canals and drains, so that these may be alternately dried without interfering with the irrigation. At Marg, when the canals became practically dry during the rotations, a certain amount of water was drawn from a sakia in the middle of the village. On one occasion when the shortage was becoming serious, a neighbouring land proprietor diverted a generous supply of clear artesian water into the Marg Canal. This, however, revived enormous numbers of molluscs which otherwise would, undoubtedly, have been killed by drying before the completion of the rotation cycle!

(4) Surface-water drains should be reduced, as far as possible, by the utilization of infiltration drains.

The Mosséri system of field drainage, which is said to be simple, economical, and extraordinarily effective, seems, of the various systems of land reclamation at present in use, to be the one most likely to produce those conditions that are unfavourable to the spread of bilharziosis.

Its dual system of "collecting" drains affords more complete control. From the section shown in fig. 39, it will be apparent that the bulk of the surface water, after irrigating the land, rapidly drains by a separate surface drain into the main drain, while the water which has soaked into the soil is drawn off by a deep infiltration drain to be pumped later into the main drain. The surface water drain can therefore be readily sterilized during the summer by drying, while if need be, the deep infiltration drain can be treated with chemical agents, or periodically cleared.

Administrative.

If a campaign against bilharziosis were commenced on the lines here proposed it is evident that the whole scheme should be under the charge of a medical zoologist, who should be attached, not solely to the Public

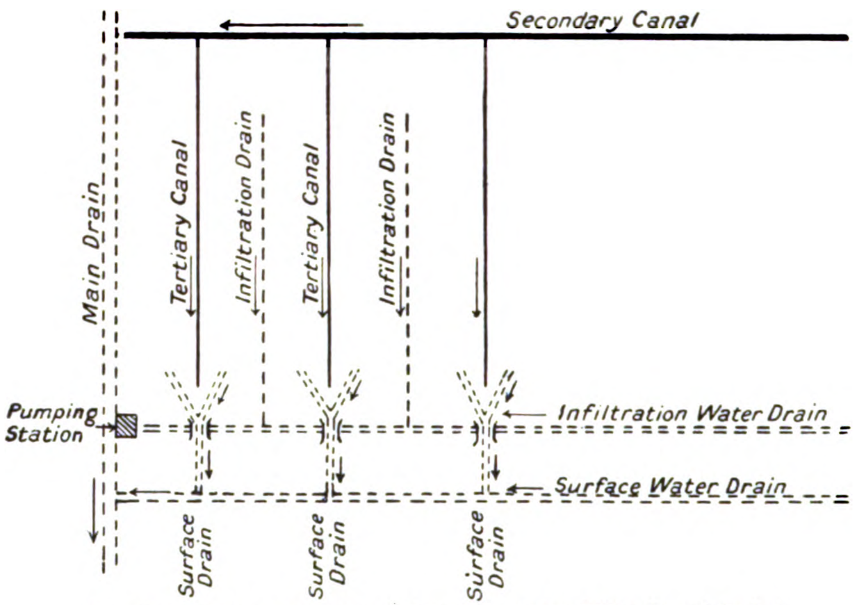


Fig. 38.—The Mosséri system of drainage. (After Willcocks and Craig.)

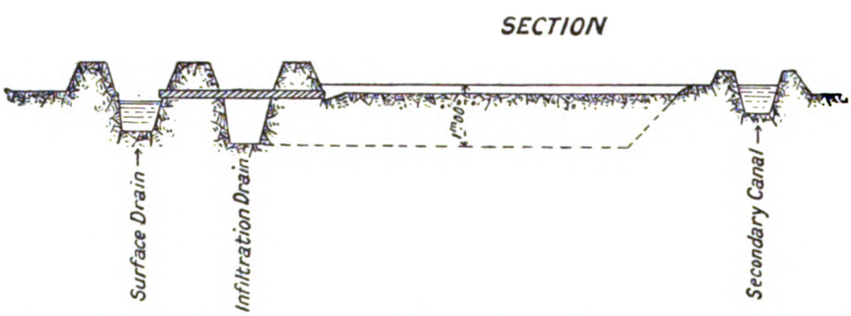


Fig. 39.—Section showing relation of infiltration and surface drainage in the Mosséri system. (After Willcocks and Craig.)

Health Service as in an ankylostomiasis campaign, but also to the Department of Irrigation. In this way only could the full and continuous effect of the present administrative control of the Nile

water be brought to bear upon the bilharzia-carrying molluscs so as to ensure their permanent eradication from lands now heavily infected and their exclusion from new areas about to be reclaimed.

Protection of Troops and Personal Prophylaxis.

Having dealt with the mode of transmission and suggested the lines upon which eradication might be effected in the course of a few years if undertaken by the State, we come now to consider the preventive measures that should be adopted by the individual, or collections of individuals, working in districts where the disease is still rife. It is obvious from what has been said on p. 47 (Part I), that in large towns where filtered water is supplied both for drinking and bathing there is practically no risk to the European. A study of the bionomics of the cercaria gives the data wherewith unfiltered water can be rendered safe where filtered water is unavailable or insufficient for all personal purposes.

Bionomics of Bilharzia Cercariæ.

Activity.

The bilharzia cercariæ move by louping and by swimming. They crawl rapidly over any surface by alternate use of the oral and ventral suckers, the tail being dragged behind passively. When swimming the tail and the whole body gyrates and the cercaria progresses with the pronged tail foremost. Swimming is not continuous. Brief periods of activity are regularly alternated with periods of rest. During these latter the cercaria very slowly sinks. When seen with a hand lens their attitudes recall slightly minute mosquito larvæ. As a rule they frequent the surface, but when a small mammal like a mouse is placed in the water they at once attack the skin. As successful infection resulted in a young mouse after only ten minutes' immersion on a single occasion they appear to be able to pierce the skin very rapidly.

Duration of Life.

In ordinary tap-water freshly discharged cercariæ usually live about twenty-four hours. A considerable number survive thirty-six hours, but none has ever been found alive after forty-eight hours. They are apparently unable to obtain nourishment from water. An infected mollusc will apparently continue to discharge active cercariæ for a long period. On two occasions infected *Planorbis boissyi* were kept in tap-water, which was renewed daily for three weeks. Large numbers of cercariæ were discharged into the water every day.

Effect of Drying. The cercariæ can survive on a damp surface from which the visible water has disappeared. They are immediately killed if the drying process is allowed to proceed to the extent of abstracting fluid from their bodies. They cannot withstand the slightest desiccation.

Need of Oxygen. Although the bilharzia cercariæ, with one exception, are not provided with eye-spots, the bulk are found near the surface of the water. They accumulate there irrespective of exposure to light. If a thin layer of oil or refined paraffin is poured on to the surface of the water the length of life of the cercariæ is reduced to a few hours. This may also be observed when a drop of water containing cercariæ is periodically examined under a sealed cover-glass. If a bubble of air has been left in the preparation it will be noticed that the cercariæ course round and round its circumference like moths around a flame.

The obvious purpose is to obtain oxygen from those portions of the water nearest the air.

Effect of Temperature. The free-swimming bilharzia cercariæ can survive a temperature of 45° C. They are killed, however, when the temperature is momentarily raised to 50° C. This corresponds very closely to the clinical finds of Conor [116] in Tunis. He noted that bilharziosis is acquired from the waters of the thermal springs at Gafsa, Tozeur and Gabès, which have a temperature of from 28° C. to 45° C., while the disease was quite absent in the neighbourhood of other springs in Tunis where the temperature ranges from 50° C. to 70° C.

Effect of Chemical Reagents. Very weak alkalies were found to have a stimulant action and weak acids an inhibitory effect on the movements of the bilharzia cercariæ. One in five hundred hydrochloric acid kills immediately. The following acids, acid salts, essential oils and antiseptics were found in dilute solutions of varying strengths to have a lethal effect on the cercariæ:—

Salicylic acid	1 in 1,000	Kills at once.
	1 in 2,000	Slight movement after 50 minutes.
Benzoic acid	1 in 2,000	Kills at once.
Sodium bi-sulphate	1 in 1,000	Kills almost immediately.
Oil of cloves	1 in 1,000	Kills in 10 minutes.
Creosote	1 in 1,000	Immediate paralysis; slight movement of tail.
Felix mas	1 in 5,000	Kills in 15 minutes.
Chinosol	1 in 1,000	Immediate effect; slight movement.
	1 in 5,000	All dead in 4 hours.

C[illegible]opurin	1 in 1,000	All dead in 50 minutes.
Microcidine	1 in 10,000	All dead in 20 minutes.
	1 in 20,000	Dead in 50 minutes.
	1 in 40,000	Dead in 2 hours 50 minutes.
Beta-naphthol	1 in 1,000	Kills immediately.
	1 in 10,000	Stopped swimming immediately.
	1 in 100,000	Fibrillar twitching and wriggling in 1½ hours; motionless in 2 hours.
	1 in 200,000	Swimming stopped in 1 hour; quite motionless in 2 hours.
Emetin	1 in 2,000	Dead in 30 minutes.
	1 in 10,000	Slight contraction at 50 minutes; dead in 3½ hours.
Thymol	1 in 1,000	Kills immediately.
	1 in 10,000	All movement stopped in ¼ hour; dead in ¾ hour.
	1 in 20,000	Swimming stopped in 2 minutes; some creeping.
	1 in 40,000	Body disintegrated in 1 hour.
Fresh chlorinated lime	1 in 30,000	Kills at once.
	1 in 50,000	Dead in 3 minutes.
	1 in 300,000	Actively swimming after 1¼ hours.
	1 in 500,000	Active after 2¼ hours.
Sodium hydroxide	1 in 1,000	Immediate immobilization.
	1 in 5,000	Actively swimming after 2 hours.
Chloroform water	1 in 1,000	Paralyzes swimming; ineffective creeping movements. On addition of water swimming regained in 5 minutes.

Effect of Temperature on Metamorphosis.

Many trematodes undergo their larval metamorphosis in molluscs during certain months of the year. Looss [290] remarked that in Egypt when the temperature falls in winter to about 5° to 6° C. the growth and multiplication of larval trematodes is sometimes wholly suspended, while in Central Europe it is only retarded at this temperature. Autumn seemed to be the most favourable period for fresh infections of intermediate hosts. During winter young parasites develop little by little but only reach the stage of cercarial production in the warm season. The appended table shows the monthly variations in the temperature of water near Cairo.

During February we found sporocysts containing secondary sporocysts and bifid-tailed cercariæ in *Planorbis mareoticus*. In March eyed bilharzia cercariæ were found also in this species. Non-eyed bilharzia cercaria were first detected in *P. boissyi* on April 17 and in *Bullinus* on June 8. Once located, the cercariæ were obtainable when desired up to the time of our departure in July. In would appear, therefore, that infection is by no means

confined to the autumn as has been generally supposed, but may be contracted during the greater part of the year.

PENETRATION. Free swimming cercariæ could not be recovered from infected waters, as they pass through the finest silk mesh. They readily pass through stocking material, and, given time, will succeed in traversing several inches of sand if there is a continuous flow of water through it. Unlike the ankylostome larvæ, they are unable to traverse ordinary filter-paper.

TEMPERATURE OF NILE WATER AT HAWAMDIA, NEAR CAIRO.

	6 a.m. (deg. C.)	4 p.m. (deg. C.)
January	14·2	14·8
February	10·3	12·9
March	16·1	16·1—18·6
April	20	21·8
May	22·4	24·4
June	25·7	27·4
July	26·7	28·1
August	26·8	27·8
September	25·5	26·5
October	25	25·5
November	21·9	21·9
December	16·8	17

(From "The Physiography of the Nile," by G. H. Lyons.)

PRACTICAL CONCLUSIONS.

From the above it may be concluded that unfiltered water taken from canals, ditches, or birkets would be rendered safe:—

(1) If kept beyond the survival period of the cercaria, i.e., for forty-eight hours.

(2) If heated to 50° C., a temperature at which the cercaria is immediately killed.

(3) If previously treated with those chemicals that are lethal to the cercaria.

The chemical sterilization of water is chiefly effected by the use of (*a*) sodium bisulphate, and (*b*) chlorine. These two substances react upon cercaria very differently in the strength at which they are more commonly used for the destruction of bacteria in water.

CHEMICAL STERILIZATION. (*A*) Sodium bisulphate is used in "tabloid" form to sterilize water for drinking purposes. Two "tabloids" are dissolved in a quart water-bottle as a rule. Each "tabloid" contains 16 gr. (1 grm.). This gives a dilution of 1 in 567. In a previous paragraph it was shown

that a dilution of 1 in 1,000 was quickly lethal to the bilharzia cercaria. These "tabloids" may therefore be used with safety in bilharzia-infected countries.

(*B*) The germicidal value of chlorine for *Bacillus coli* according to Captain Nesfield is 1 in 760,000 acting for ten minutes. 1 in 1,000,000 acting for half-an-hour is in common use. There is one part of available chlorine in three parts of fresh chlorinated lime. One part of chlorinated lime in 300,000 with half-an-hour's contact is therefore an efficient bactericide. From the tabulated effects of chemical reagents on the cercaria it will be seen that this dilution would not have the slightest effect upon the activity of the bilharzia cercaria. It would be necessary to use twenty parts of bleaching powder per 1,000,000, and afterwards to dechlorinate in order to render water taken from the canals and ditches in Egypt free from bilharzia infection.

Attention should be given to the following points :—

(1) Personal contact of any kind with unfiltered water is risky. The surface of the water is the most likely to be infective as the cercariæ congregate there. An intake pipe should always be led therefore to the centre of the stream and should draw the water from near the bottom and at a place where there is little or no vegetation.

(2) It is essential in drawing water for storage, in order to destroy the bilharzia cercaria, that no infective mollusc be admitted. This can be ensured by screening the intake pipe with gauze having about sixteen meshes to the linear inch. The common mosquito gauze or phosphor-bronze wire gauze is very serviceable.

(3) The water in the wells and "sakias" may be regarded as much safer than that from other sources. Hitherto molluscs have not been found in these wells.

(4) Shallow barrel sand-filters are open to suspicion. It has been found experimentally that after fifteen minutes cercaria succeed in passing in large and increasing numbers through four inches of desert sand.

(5) Although the reproductive activity of bilharzia in the molluscs is probably most intense during the summer months the occurrence of mature cercariæ in infected molluscs in February shows that there is a certain liability to the infection throughout the year.

(*To be continued.*)

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(*To be continued.*)

THE CAUSATION AND PREVENTION OF ENTERIC FEVER IN MILITARY SERVICE, WITH SPECIAL REFERENCE TO THE IMPORTANCE OF THE CARRIER.

BEING AN ACCOUNT OF WORK DONE AT NAINI TAL ENTERIC DEPOT, 1908-11.

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(*Continued from p.* 120).

NOTES ON CARRIERS AT THE DEPOT IN 1908.

(1) On April 27, Private H., Bedford Regiment, was found to be passing typhoid bacilli in his fæces. This man had had a severe attack of enteric fever in Jhansi in March, 1907, and had been at Kasauli from June, 1907, to March, 1908. He arrived at Naini Tal in April, 1908. While at Kasauli his excreta were for a time examined daily, and he passed typhoid bacilli frequently, at first both in his fæces and urine, latterly only in his fæces and at longer intervals. The bacillus was again isolated from the stools at Naini Tal on several occasions, and as there was no doubt that this man was a chronic carrier, his name was submitted to headquarters, and he was invalided home in November, 1908. This man looked pale, but stated that he felt perfectly fit. He had no symptoms of cholecystitis, and as his serum only gave a low index for typhoid, there was really no indication of his condition. A vaccine was prepared from the strain isolated from the fæces, but owing to pressure of other work I was unable to proceed with this line of treatment.

On November 25, 1908, the day before he left the depot for England, the *Bacillus typhosus* was again isolated from the fæces.

Agglutination.

	20	40	100
Stock strain	±	–	–
Own strain	–	–	–

Phagocytic index, average five per cell.
Opsonic index, average less than one per cell.

The examinations of this man were continued in England, He was invalided out of the Service in 1910, and is still a carrier (1911).

[1] Now Lieutenant-Colonel.

(2) On July 17, Private L., 1st Bedfordshire Regiment, came sick complaining of pain in the right hypochondrium. His fæces were examined on the following day, but no typhoid bacilli were found. On the next day, however, numerous typhoid colonies were evident. This man had a severe attack of enteric fever in Jhansi in April, 1907, and on arrival at Kasauli in June had a severe attack of cholecystitis with fever, and there were large numbers of typhoid bacilli in his fæces. He arrived at Naini Tal in April, 1908. He looked quite fit, but from time to time got attacks of cholecystitis, which were a clue to his condition. These attacks became less severe and were latterly not so frequent. It was during one of these attacks at Naini Tal that the *B. typhosus* was recovered from his fæces one year and four months after his fever. He was invalided to England in November, 1908.

Agglutination.

	20		40		100		200		400
Laboratory strain ..	±	..	±	..	±	..	±	..	Trace

Phagocytic index, average per cell, 17.

(3) On September 1, Gunner C. was found to be passing typhoid bacilli in his fæces in large numbers. He had been admitted to the Station Hospital, Meerut, in March, 1908, and passed through a severe attack of fever. He was a constant carrier. The examinations of the urine were negative. He occasionally had slight looseness of the bowels, but had no cholecystitis, and he was invalided home in November, 1908.

Agglutination.

		20		40		100
2.7.08.						
Stock strain	..	±	..	±	..	±
Own strain	..	−	..	−	..	−
14.11.08.						
Stock strain	..	+	..	±	..	±
Own strain	..	+	..	±	..	−

(4) On September 3, 1908, Bombardier S. was found to be passing typhoid bacilli in his urine in pure culture. This man had been admitted to hospital in Fyzabad in May, 1908. He proved to be a constant carrier. The urine was invariably perfectly clear to the naked eye and contained no albumin or pus and was acid in reaction. He was invalided to England in December, 1908.

(5) On November 20, 1908, Private O'N., the Cameronians, was found to be passing a bacillus, resembling the *B. typhosus*, in his fæces in small numbers, and again on November 26 the same

bacillus was isolated. This man had passed through a mild attack of fever in Cawnpore in 1908. He was invalided to England as a carrier in December.

The excreta of this man was examined in England frequently after his arrival. The *B. typhosus* was never found, and he was accordingly returned to duty.

I believe in this case I was misled by a bacillus closely resembling the *B. typhosus;* it was at once agglutinated macroscopically by high titre typhoid serum, and the serum of Private O'N. agglutinated this bacillus in the same dilutions as it did the stock *B. typhosus.* The sugar reactions were apparently correct, but at this time nutrose water sugar tubes were used instead of peptone water. I am convinced that if time had permitted further investigations, such as repeated and prolonged tests in the sugar tubes, with absorption experiments, the mistake would have been obviated. Even now after the lapse of four years I have a very distinct recollection of remarking that the colonies of this bacillus owed their transparency to the fact that they were flat and thin, whereas true typhoid colonies, although possessed of a good body, have, as it were, an inherent transparency. I am quite certain that I have met with this bacillus on subsequent occasions in other cases, but was able to overcome the difficulty of differentiation by fuller investigation.

AGGLUTINATION.

	20	40	100
Stock strain	+ ..	± ..	−
Own strain	+ ..	± ..	−

In 1909, as already mentioned, the improved equipment being available, a great many more examinations were made, with the result that during the year the fæces and urine of three hundred and sixty men were examined on an average twelve times.

Eight thousand two hundred samples of excreta were examined and six carriers of bacilli of the typhoid group were detected. Notes of the cases of these men are appended.

Conradi's new brilliant green medium was given an extended trial, but was abandoned in favour of the original blue medium, for the following reasons:—

(I) Its use involves more expense, as a large quantity of peptone is required.

(II) *Coli* colonies do grow on it although not so freely as on the old (one-third less), but as they and also the typhoid colonies are inhibited they cannot readily be distinguished.

(III) When it is necessary to examine fifty or sixty plates daily it is essential that one should be able to pick out, after twenty-four hours' incubation, likely from unlikely colonies. This is possible on the old, not on the new medium.

In addition to the routine work of the depot, a small epidemic of paratyphoid fever was investigated, and as this was the first series of cases, diagnosed by cultural methods, described in India, some mention is made of it here. This also leads up naturally to a consideration of the paratyphoid problem in military service in India, a problem which has now assumed considerable importance.

These cases all occurred in a camp near Naini Tal, about four miles from the depot and on the opposite hill. One hundred and fifty men from the Lucknow garrison were accommodated in this camp during the hot weather.

The first case of fever was proved to be true enteric fever by the isolation of the *B. typhosus* from the blood. This was a mild case of fever and quite indistinguishable from the others on clinical grounds, except that the pulse-rate was slow throughout.

TABLE.

		Culture. Paratyphoid A		
Name	Date of admission	Blood	Fæces	Urine
Corporal H.	15.4.09	+ (in relapse)	–	–
Private P.	6.5.09	+	+	–
,, G.	16.5.09	+	–	–
Lieutenant P.	17.5.09	+	–	–
Serjeant B.	3.6.09	+	–	–
Private D.	1.7.09	+	–	–
,, F.	18.7.09	+	–	–
,, B.	22.8.09	–	+	+
Serjeant Br.	15.10.09	+	+	–

It will be noted that although in all cases the excreta of these men was examined daily from the time of admission to hospital and throughout the fever the *B. paratyphosus* A was only recovered in three cases from the fæces and once from the urine. The *B. paratyphosus* A was recovered from the blood in eight of the nine cases. One man became a carrier and continued to excrete the bacillus in his fæces for more than three months after the fever had ceased. He was sent home time-expired, so further examinations were not carried out. In another case (Private B.) the bacillus was found in the fæces for a month after the fever had ceased, but not later; and in the case of Serjeant Br. it was only found during the fever and not later.

The Widal reactions are given in tabular form :—

	Date of fever	Date of Widal	T. 1/20	T. 1/40	T. 1/100	A. 1/20	A. 1/40	A. 1/100
Case I	18.4	12.5	+	+	±	Trace	–	–
,, II	3.6	21.10	±	Trace	–	±	∓	–
,, III	9.5	11.5	+	+	±	±	∓	Trace
,, IV	16.5	9.6	±	±	∓	±	∓	Trace
,, V	17.5	23.5	±	∓	Trace	–	–	–
,, VI	1.7	9.7	±	Trace	–	–	–	–
,, VI	1.7	29.7	±	Trace	–	–	–	–
,, VI	1.7	13.10	Trace	–	–	±	Trace	–
,, VII	18.7	1.8	±	±	Trace	Trace	Trace	–
,, VII	18.7	13.8	±	Trace	–	±	±	∓
,, VIII	22.8	4.9	+	+	±	±	∓	Trace.
,, IX	15.10	18.10	±	±	Trace	±	±	–

In all cases the agglutination showed first in the 1 in 20 A tubes, even if the final result was only "Trace" 1 in 20. No comments are made on these reactions, as they are considered later when dealing with the paratyphoid problem generally.

It has been recognized in India for some years that the "pyrexias of uncertain origin" offered a rich field for investigation. In one large hospital where the writer was doing duty there were, in one six months, when no laboratory work was possible, one hundred and sixty-four cases of fevers of uncertain origin. In the following six months, when the laboratory and the "special" ward were in the hands of a trained worker there were only three such cases.

A large number of these fevers of uncertain origin are undoubtedly malarial in origin. In some hospitals only those cases of fever in which the malarial parasite has actually been demonstrated are diagnosed malaria. Many more will be accounted for by "sand-fly fever," and some by true influenza. But this will still leave some which are true paratyphoid fevers and mild enteric fevers. On the other hand, a considerable number of cases diagnosed as true enteric fever are really paratyphoid fevers.

There is, of course, little danger to the community in this particular error. At the same time, it is one which should not be permitted to occur, as it throws doubt on the efficacy of anti-typhoid inoculation. The writer is of opinion that a large percentage of the mild cases of enteric fever "modified by inoculation" are really paratyphoids.

The following figures are taken from the Annual Report of the Naini Tal Depot for 1911, by Captain J. L. Wood, R.A.M.C. :—

Of 18 enteric cases proved by blood culture, 9 were not inoculated; of 39 clinically enteric, 19 were not inoculated; of 85 paratyphoid cases proved by blood culture, 5 were not inoculated. Or to put it in another way: Of 57 enteric fevers 50 per cent. were inoculated; of 85 paratyphoid cases 95 per cent. were inoculated.

It will be readily understood that the differentiation of paratyphoid fever from true enteric is important, but the removal of the paratyphoids from among the pyrexias of uncertain origin is of vital importance.

The ætiology of typhoid and paratyphoid fever is similar, that is to say, in both cases man is the storehouse of the virus, and cases arise by contact with infected persons. This has already been shown in the instance of two small epidemics caused by acute or temporary carriers. Apparently temporary carriers are more common after paratyphoid fever than after typhoid; the difference, however, is only apparent and not real. Typhoid is, as a rule, a severe disease. It "bowls" its victim over and convalescence is slow and prolonged. The convalescent accordingly does not arrive at the depot until at least three months have elapsed since the cessation of his fever, thus eliminating at least 10 per cent. of carriers. On the other hand, paratyphoid fever is, as a rule, a mild affection, convalescence is remarkably rapid, and the men often arrive at the depot within a month *of their admission to hospital*, with the result that on arrival many are found to be excreting the bacillus, and continue to do so for short periods, thus giving the erroneous impression that temporary carriers are more common among paratyphoid convalescents than among the typhoid. If typhoid fever cases are examined in the first month of convalescence the proportion of temporary carriers is just as high.

This very mildness of the disease and rapid convalescence in paratyphoid fever constitutes a danger, as the correct diagnosis may not be made and the man may be returned to duty while still infective. It is therefore essential that every case of paratyphoid fever should be correctly and rapidly diagnosed if this fever is to be eliminated from the records as typhoid fever has been.

The writer would like to see paratyphoid fever stamped out of the Army without the aid of special inoculation, and this stamping out is possible by means of rapid and accurate diagnosis of all such cases, with their segregation and examination in the depots, and, as a matter of course, strict attention to all sanitary details.

This will mean, for a year or so, a slight rise in the incidence

of enteric fever, but if it is recognized that this is only a temporary one and is due to more accurate diagnosis of the unrecognized fevers, it will be an advance rather than a retrogression.

A disquieting feature of this question is the fact, as reported by Captain Wood, R.A.M.C., in his Anuual Report of the Depot for 1911, that a considerable proportion of the bacilli, isolated by blood culture from cases of fever among sepoys of the Native Army, are paratyphoid A, but with the active co-operation of the I.M.S. officer this danger may also be eliminated.

The paratyphoid problem in India centres in the paratyphoid A variety, whereas in Europe the variety most commonly met with is paratyphoid B. In no authenticated case so far has the *Bacillus paratyphosus* B been isolated from the blood of a case of fever in India, and out of twenty-eight thousand samples of excreta examined at the Naini Tal Depot, and from which all non-lactose-fermenting colonies were investigated, the *B. paratyphosus* B was never met with.

Paratyphoid fever may be so slight that the man may never report sick, as already noted in a case described by Major Grattan and Captain Wood. Such cases will only be detected if they give rise to further cases.

Clinically, paratyphoid fever resembles a mild enteric fever, but differs in the following particulars: The onset as a rule is rapid and is frequently accompanied by a rigor (I have heard it said by officers that they have seen typical enteric fever in which the onset was rapid and accompanied by a rigor, but these were in pre-blood culture days), sore throat is a very common initial symptom, and the pulse-rate is as a rule more rapid (120) in the early stages than in uncomplicated enteric fever. Clear mental condition is a feature of all cases, and even in prolonged fever the typhoid state is not met with. Hæmorrhage is exceptional, but death from perforation of the only ulcer has been reported.

The writer has seen in two cases a morbilliform rash extending over the entire body, limbs, and face. In one of these cases this rash appeared during the fever, disappearing on defervescence and reappearing during a relapse, to disappear again when the temperature touched normal. The *B. paratyphosus* A was recovered from the blood both during the initial fever and again in the relapse.

Relapses are common, and inflammation of the veins of the leg may also follow, giving rise to a typical enteric leg.

The mortality is less than one per cent.

By a recent ruling (1910), only those cases are to be returned as paratyphoid fever in which the bacillus has been recovered from the blood. It is not possible to do a blood culture in every case at the commencement of the fever, and, therefore, if the above ruling is rigidly adhered to many cases of paratyphoid fever, which could be definitely diagnosed on clinical grounds combined with the Widal reaction, will be included among pyrexia of uncertain origin. Even if these cases were regarded as dangerous it would not be possible to keep them long enough in hospital to ensure safety.

During the year 1911 one hundred and thirty-eight cases of fever were sent up to the depot as probably paratyphoid fever, although in all blood culture had been negative. Of these, five were found to be excreting the *B. paratyphosus* A, and one of these men continued to excrete this bacillus for six months after his fever.

Blood culture should be attempted in every case at the earliest opportunity, but if this fails it is quite possible to diagnose paratyphoid fever on clinical grounds in combination with a close study of the Widal reactions. This Widal reaction in paratyphoid fever (A variety) is peculiar, and in the writer's opinion specific. A study of the Widal reactions in over one hundred cases has shown that in the early days of the fever the agglutinins are not present, but as a rule the group reaction for *B. typhosus* begins to appear before the specific reaction for paratyphoid A. This group reaction for the *B. typhosus* may reach as high a titre as that obtained in an attack of true enteric fever—i.e., up to a dilution of 1 in 200. The reaction for paratyphoid is, as a rule, lower, and may only be demonstrated in such dilutious as 1 in 20 or 1 in 40, and only exceptionally complete in either. A peculiarity of this reaction is that almost invariably the agglutination commences first in the sedimentation tubes which contain the lower dilutions of paratyphoid serum, whereas the agglutination in the typhoid tubes does not show until some hours later. This paratyphoid agglutination appears as a faint feathery haziness up and down the tube within half an hour of mixing the emulsion with the serum. The typhoid reaction may not appear until the following day, when it may be complete in 1 in 40 dilution and nearly complete in 1 in 100, whereas, little further change takes place in the A tubes—i.e., 1 in 20 incomplete, 1 in 40 a trace. When the writer first noticed this phenomenon, he was in the habit of putting up higher dilutions, in order to obtain an end-point, only to find that the original 1 in 40 was quite sufficient for this purpose.

The agglutination reaction for paratyphoid A is frequently transient and may only be present for a few days in the later stages of the fever, or in early convalescence, and in most cases it disappears entirely in a few weeks, although in one case the writer found it still present one year after the fever. The group agglutinins for *B. typhosus* produced by an attack of paratyphoid fever also disappears quickly, in contrast to the specific agglutinins for typhoid, produced by an attack of true enteric fever, which remain for months and years in some cases. This rapid disappearance of both specific and group agglutinins accounts for the apparent anomaly of a man passing through what was, clinically, a mild attack of enteric fever, and yet giving a few weeks later an entirely negative Widal reaction. This has happened at the depot in several cases in which the *B. paratyphosus* A has been isolated from the blood during the fever and whose serum had given a high Widal reaction for both bacilli. Or, again, both reactions may be so slight or transient during the fever and convalescence as to be ignored and returned as negative. This happened in the experience of the writer in one case at least before he realized that a reaction in a dilution of 1 in 20 for paratyphoid A is not unimportant.

It will be seen from the above remarks that the accepted teaching regarding Widal reactions holds good so far as typhoid is concerned—i.e., a case should not be diagnosed as enteric unless a reaction is obtained in a 1 in 100 dilution; but not so in paratyphoid A, as in this instance a reaction in a 1 in 20 dilution, even although it be not complete, should not be ignored.

Absorption experiments were also carried out in some cases, to determine the group and specific agglutinins, and examples of some of those are appended.

In cases due to infection with the *B. paratyphosus* A whose serum agglutinated both the paratyphoid A and typhoid, absorption with A removed all the agglutinins, or if the man had been inoculated reduced those for typhoid to the level that obtained before the fever. Absorption with *B. typhosus* removed only the group agglutinins for this bacillus but not those for *paratyphosus* A, even although these had only been present in a 1 in 20 dilution. This rule, however, is not invariable, as in some cases the titre for paratyphoid A was considerably reduced by absorption with the *B. typhosus*, although the cases had been proved by blood culture to be true paratyphoids; but this was exceptional. Curiously enough, group agglutinins for A in typhoid cases were only very rarely met with.

ABSORPTION EXPERIMENTS.

Private K.'s serum. Chronic carrier, *Bacillus paratyphosus* A. Twice inoculated against enteric fever.

	Dilution	20	40	100
Before absorption	T.	±	±	Trace.
	A.	±	±	..
After absorption with *Bacillus typhosus*	T.	–	–	..
	A.	±	–	..
After absorption with *Bacillus paratyphosus* A	T.	∓	–	..
	A.	–	–	..

Serjeant B.'s serum. Carrier of paratyphoid A.

	Dilution	10	20	40	100
Before absorption	T.	+	+	±	∓
	A.	±	∓	–	..
After absorption with *Bacillus typhosus*	T.	–	–	..	..
	A.	±	∓	–	..
After absorption with *Bacillus paratyphosus* A	T.	..	–	–	..
	A.	–	–	–	..

Serum of Private J. Typhoid convalescent.

	Dilution	10	20	40	100
Before absorption	T.	+	+	∓	–
	A.	±	∓	–	..
After absorption with *Bacillus typhosus*	T.	–	–	..	..
	A.	–	–	..	..
After absorption with *Bacillus paratyphosus* A.	T.	+	±	∓	–
	A.	–	–	–	..

During the year 1908 it was specially noted that paratyphoid cases were not to be sent to the depot, as there was barely accommodation for the true typhoids, and it was well known that an attack of paratyphoid fever did not protect against true enteric.

In spite of this, several men were sent up to the depot as enteric fever convalescents who had had paratyphoid fever, and one of these, Private H., Sussex Regiment, contracted typhoid fever in the depot, the *B. typhosus* being recovered from his blood and fæces. This man on arrival at the depot gave a completely negative Widal reaction, although his chart was typical of a mild enteric fever (fifteen days' fever) and his Widal reaction during his fever was returned as positive 1 in 40, *B. typhosus.*

On looking over the charts of the men who were in the depot in 1908 in the light of more recent experience, the writer is of opinion that there were about fifty cases sent up which were probably paratyphoid, whereas in 1910 there were over one hundred diagnosed by blood culture and Widal reaction. (In that year, 1910, paratyphoid cases were received at the depot.) In 1911

there were no fewer than two hundred and sixty-three paratyphoid fever convalescents at Naini Tal.

The figures for 1911 were as follows :—

		Enteric fever		Paratyphoid fever
Blood culture	..	18	..	90
Clinically ..	..	39	..	173
		57	..	263

It will be noted that in the year 1911, from the whole of Northern India, out of one hundred and eight (108) cases of successful blood culture, ninety were due to *B. paratyphosus* A, and eighteen due to the *B. typhosus*, although it is obvious that the latter is much more readily recovered from the blood as it is present therein for a much longer period than is the former.

There can be little doubt, then, that, thanks largely to preventive inoculation and segregation of convalescents, true enteric fever has practically disappeared from among the troops in India, whereas if paratyphoid fever has not increased it has certainly not diminished. This is, to my mind, the very strongest argument possible that the recent remarkable reduction of enteric fever is due almost wholly to inoculation. If, however, segration and removal of carriers is given fair play against paratyphoid fever as it has been against typhoid, then the former disease will also soon disappear from the records and the paratyphoid problem will be solved.

Notes on Carriers Detected during the Year 1909.

That the coming event of paratyphoid incidence was already casting its shadow before was evidenced by the fact that out of the six carriers detected, three were carriers of paratyphoid bacilli, two of the typhoid bacillus, and one had a chronic bone infection due to the *B. typhosus*.

Case 1.—Private B., Highland Light Infantry, was admitted to hospital in Darjeeling in September, 1908. He had a prolonged fever of a remittent and occasionally intermittent character. During convalescence his pulse-rate was rapid. He arrived at the Naini Tal depot on December 12, 1908. On examination of his urine it was found that he was passing a bacillus resembling the *B. paratyphosus* B in the appearance of the colonies. These colonies where closely packed were small, blue, and transparent, but where they had room to grow out showed a definite greyish-purple centre. The urine was turbid and contained a small quantity

of albumin. On centrifuging, a few pus and blood cells were seen and an occasional tube cast (blood). A count of the urine showed that there were forty million bacilli per cubic centimetre present, on an average.

On January 12, 1909, his serum gave the following agglutination reactions :—

	1/20	1/40	1/100
Bacillus typhosus	Trace	–	–
Paratyphoid A	+	+	±
Paratyphoid B	–	–	..
Urine bacillus	±	∓	Trace

The bacillus isolated from the patient's urine gave the following reactions :—

A short, thick, feebly motile Bacillus, non-Gram-staining.

	24 hours	48 hours	5 days
Lactose	Faint acid, no gas	A + G	..
Glucose	A + G	A + G	..
Maltose	A + G	A + G	..
Mannite	A + G	A + G	..
Saccharose	A + G	A + G	..
Litmus milk	Acid	Acid, no clot	Acid, no clot.
Peptone water	–	–	Indol, trace.
Neutral red agar	Gas and fluorescence	..	..
Gelatine	No liquefaction	..	..

Conradi's blue medium: Small colonies, blue and transparent.

Plate culture: Large colonies, purple-grey centre.

Neutral red agar plates: Clear transparent colonies, no red centres even after five days.

Coli colonies on the same medium showed a bright red centre in twenty-four hours.

The subcutaneous injection of three cubic centimetres of a forty-eight hours broth culture had no effect whatever on a young guinea-pig. The bacillus was not agglutinated either by typhoid or paratyphoid high titre serum. Urotropine, ten grains three times a day for a fortnight, and then twenty grains t.i.d. for three days, was given, but the drug had no effect whatever on his condition.

In March, 1909, a vaccine was prepared from the bacillus isolated from the urine, the growth on an agar tube being scraped off into eight cubic centimetres of normal saline solution and sterilized by heating to 58° C. for one hour. A dose of, approximately, three hundred million bacilli was given subcutaneously on March 16. There was a marked local and general reaction which, however, was not followed by any amelioration of the renal condition.

His agglutination reaction on March 27, 1909, was as follows:—

	1/20	1/40	1/100
Bacillus typhosus	Trace	–	–
Paratyphoid A	+	±	Trace
Own bacillus	+	±	∓

Serum of a Convalescent from Enteric Fever.

	1/20	1/40	1/100
Bacillus typhosus	+	±	Trace
Paratyphoid A	–	–	..
Urine bacillus of Pte. B.	±	±	∓

On March 30, 1909, a second dose of vaccine was given. No reaction beyond a slight local one followed this inoculation, and it had no effect on the excretion of the bacillus.

In July, 1909, Private B. was discharged from the depot quite well "in himself," but still passing the bacillus in his urine in large numbers. From December, 1908, till July, 1909, the bacillus was invariably present from day to day and always in pure culture on Conradi plates. In 1910 this man died of meningitis, but, unfortunately, as he died at an out-station, no cultures were made *post mortem*, and no cause for the meningitis was given. I think there can be little doubt that the causal organism was the one which had established so firm a hold on his kidney.

CASE 2.—Gunner S. arrived at the depot on April 8, 1909, from Meerut, where he had suffered from a severe attack of enteric fever. It was stated on his case-sheet that he had suffered from periostitis. On arrival at the depot he had several nodes on the tibia and ulna, and about a week later he developed a painful swelling on a metacarpal bone. A needle was inserted into this, but no fluid could be obtained and no growth resulted from the cultivation.

On June 16, 1909, three months after his arrival at the depot, and six months after his attack of fever, he was struck on the shin over the site of one of the nodes by a football. This node became inflamed and a small abscess resulted. Some of the pus was drawn off by a syringe and a pure growth of the *B. typhosus* was obtained both in bile and directly on a Conradi plate. As he had at least six of these nodes remaining he may fairly be classed as a chronic carrier (osteal) of the *B. typhosus*.

CASE 3.—Private P., Royal Dragoons, was admitted to the Station Hospital, Naini Tal, on April 10, 1909. The *B. paratyphosus* A was isolated from his blood. He made a good recovery,

but during convalescence suffered from attacks of fever with cholecystitis, and the *B. paratyphosus* was present in his fæces for more than three months. He proceeded home, time-expired, in October.

August 10, 1909. Agglutination reactions :—

Dilution of serum		1/20		1/40		1/100
Stock *B. paratyphosus* A.	..	±	..	Trace	..	–
Private D.'s strain*	..	±	..	±	..	Trace
Own strain ..	..	±	..	±	..	"
Private F.'s strain*..	..	+	..	±	..	∓
Stock *B. typhosus*† ..	..	+	..	+	..	±

* Strain isolated from the blood of other cases in the same small epidemic.

† Private P. had *not* been inoculated against enteric fever.

Case 4.—In March, 1909, Gunner S., 58th Battery, Royal Field Artillery, was found to be passing the *B. typhosus* in his fæces daily and almost in pure culture. He had no symptoms of cholecystitis and was invalided home at once.

Case 5.—Private W., Durham Light Infantry, arrived at the depot on June 2, 1909, from Nasirabad, where he had suffered from a very severe attack of enteric fever.

June 12, 1909. Widal reaction :—

			1/20		1/40		1/100
B. typhosus	..	..	+	..	+	..	+

Not tested for paratyphoid.

In due course his fæces and urine were examined, and the *B. paratyphosus* A was recovered from his fæces on several occasions in September, eight months after the fever.

September 12, 1909. Widal reaction :—

			1/20		1/40		1/100
B. typhosus	..	..	+	..	±	..	Trace
B. paratyphosus A ..		..	+	..	±	..	∓
Own strain	..	..	+	..	+	..	+

It will be noted that this man's serum agglutinated the stock paratyphoid A in higher dilutions than did the serum of the more recent cases of fever.

Private W. stated that he suffered from morning headaches and had never felt fit since the attack of fever. On examination a tender spot was found in the gall-bladder region.

Although the bacillus isolated from the man's fæces resembled the *B. paratyphosus* A in culture reactions and morphologically, it differed somewhat in its agglutination reactions, as it was readily

agglutinated by normal human serum. Two cubic centimetres of a broth culture of this bacillus when injected into a guinea-pig did not kill it, but produced agglutinins for the stock *B. paratyphosus* A; and absorption of the high titre serum by this bacillus removed both the specific and group agglutinins.

CASE 6.—On December 6, 1909, Private C., 12th Lancers, arrived at the depot from Sialkot, where he had fever in September. When riding up from the station to the depot he was suddenly seized with acute pain in the right side and fainted. He was brought up to the depot in a dhooly. When examined there was tenderness and rigidity of the right side of the abdomen, and he complained of great pain in the right iliac fossa. He had a temperature of 101° F., and his blood showed a marked leucocytosis. As he had had an appendix abscess opened three years before without removal of the appendix, it was thought that this attack might be due to a recurrence of the old trouble, but on an examination of his fæces the *B. typhosus* was found in very large numbers, and the following day the pain had definitely located itself in the gall-bladder region. He made a good recovery, but continued to excrete the *B. typhosus* in his fæces daily and almost in pure culture. A vaccine was prepared from his own strain and he received five doses at intervals of ten days, three hundred million bacilli in the dose, but no improvement took place in his condition, and he proceeded home, time-expired.

In the year 1909, in addition to these typhoid carriers, two other interesting cases were reported.

(1) Chronic carrier, amœbic. This man had suffered from dysentery before arrival at the depot, and while in residence there had several short attacks easily controlled by ipecacuanha. During these attacks amœbæ were present in large numbers in the stools. The interesting point was that during the intervals, when his fæces were normal, amœbæ were freely present.

(2) Several instances of apyrexial malarial carriers were also noted and reported.

In the year 1910, 239 men arrived at the depot, and 253 were examined and sent down; 3,574 samples of fæces and 3,219 samples of urine were examined. The excreta of each man was examined on an average fourteen times; 6 carriers of bacilli of the typhoid group were detected, 2 were typhoid carriers (fæcal) and 4 were paratyphoid (also fæcal). It is interesting to note that out of the 239 cases sent up to the depot more than 100 were, from a study of the charts and case-sheets and Widal reactions, due to the

B. paratyphosus A. This is also evidenced by the fact that of the 6 carriers detected 4 were paratyphoid.

During the year an extended trial was given to Fawcus's modification of Conradi's medium. The use of this medium was, however, not continued, for the same reasons that were adduced in the case of Conradi's own green medium: (1) Expense; (2) inhibits both *coli* and typhoid; (3) necessity of incubating more than twenty-four hours.

Padlewski's medium was also given a trial. This is a good medium when only a few plates are required, as the typhoid colonies are large and characteristic in twenty-four hours, but it is more expensive and more difficult to make in large quantities than the blue medium, and is also more liable to become overgrown.

A further series of experiments to test the viability in nature in the fæces of chronic carriers of the *B. typhosus* and *B. paratyphosus* A were also carried out, and the results have been recorded above.

Notes on Carriers discovered during 1910.

Case 1.—No. 9273, Private H., King's Liverpool Regiment, arrived at the depot on September 19, 1909, but owing to the large number of men in the depot at that time it was not possible to examine him until January, 1910, when he was at once found to be a constant carrier (fæcal) of the *B. typhosus*. He had had a severe attack of fever in Subathu in May, 1909, and during the fever had been treated with doses of curative vaccine. The question has suggested itself, had this treatment anything to do with his subsequent condition as a carrier? He had two or three definite attacks of cholecystitis, diagnosed as malaria, at Subathu during convalesence.

On October, 1909, he was admitted to the depot hospital in a comatose condition, with a temperature of 101° F. There were no malarial parasites in his blood and no quinine was given. His pupils were equal but inactive, and his knee-jerks absent. Forty-eight hours after his admission to hospital he quite suddenly woke up and had no recollection whatever of his illness. It was thought at the time that his condition was due to a blow on the head, of which there was a doubtful history but no marks. It is just possible, however, that this illness may have been due to his condition as carrier, of which one was not aware at the time. He made a good recovery, and there were apparently no after-effects, although at no time was his mental condition bright. As soon as it

was known that he was a carrier he was put on vaccine treatment in February, eight months after his fever. He received two courses of five doses of autogenous vaccine, but although his opsonic index was markedly raised the treatment had no effect on the excretion of the *B. typhosus*. He was invalided home *in statu quo*.

CASE 2.—Colour-Serjeant W., King's Own Regiment, arrived at the depot on February 1, 1910, from Lucknow; here he had had a fairly severe attack of fever in December, 1909. There was a history of cholecystitis during the fever. He was examined at once on arrival at the depot, and was found to be excreting the *B. typhosus* in large numbers in his fæces daily. He was at once put on vaccine treatment—i.e., within two months of the cessation of his fever—and received four doses of autogenous vaccine, three hundred million bacilli in each dose, during February and March. At the end of March he quite suddenly ceased to excrete the *B. typhosus*, and although examinations were continued till October, all were negative. He was then allowed to rejoin his unit.

In July, Colour-Serjeant W.'s wife was allowed to join him in the depot, where they lived together till October. Mrs. W. had never had enteric fever, but had been recently inoculated. She never had fever in the depot.

As this man had fever in December it will be noticed that he only continued to excrete the bacillus for three months, and therefore it is possible that his was a spontaneous cure. At the same time, as the vaccine treatment was begun at the earliest possible moment, it may be conceded that it was at any rate a factor in the successful result.

CASE 3.—Private M., King's Dragoon Guards, arrived at the depot on July 7, 1910, from Umballa, where he had had a severe attack of fever in April, which had been diagnosed as true enteric on the clinical signs and Widal reactions; but on his arrival at the depot his serum gave the specific reaction for paratyphoid A, and on examination of his fæces this bacillus was found almost in pure culture. This man was also at once put on treatment by autogenous vaccine. As this was the first case treated by a paratyphoid vaccine, the initial dose was fifty million bacilli, increased later to one hundred million, but no larger dose was given, as even with the first dose there was a considerable local and general reaction. This man at the time was somewhat anæmic and debilitated, due to syphilis, and he subsequently developed a gumma of the foot. Therefore, perhaps he was not a very suitable subject for vaccine treatment. He received in all four doses of vaccine,

and ceased quite suddenly to excrete the *B. paratyphosus* A in October, 1910, having been a carrier for six months. This man's general condition was much improved during his course of vaccine treatment, as he put on weight and gained colour in quite a remarkable manner.

Case 4.—Lance-Corporal D., 8th Hussars. The serum of this man had given a positive reaction for the *B. paratyphosus* A while in hospital. As the blood culture was negative his case was diagnosed "pyrexia of uncertain origin," but as the senior medical officer and the medical officer in charge of the case were of the opinion that he had suffered from paratyphoid fever he was sent up to the Station Hospital, Naini Tal, for further examinations. His excreta were examined at least four times with negative results, but as his serum still gave a positive reaction to the *B. paratyphosns* A, he was sent out to the depot on August 19, 1910. On arrival there his excreta were again examined for one week, with negative results. But when he came up for his final examination six weeks later he was found to be passing the *B. paratyphosus* A in his fæces in large numbers. He was, therefore, an intermittent carrier and only passed the bacillus at intervals during one month, all subsequent examinations up to March, 1911, were negative, and he was then returned to duty. He was not treated with vaccines, but ceased spontaneously to excrete the bacillus. This type of case is a difficult one to legislate for, as ten examinations made during early convalescence were negative, and had the patient been discharged then, he would subsequently have become a danger to others.

Case 5.—The case of Private K., Middlesex Regiment, has already been referred to. Four months after his fever he was still excreting the *B. paratyphosus* A, but ceased spontaneously about a fortnight after his arrival at the depot. He had been discharged to duty in the early weeks of convalescence while still infective and caused twelve cases of fever in his barrack-room.

Case 6.—No. 9218, Private B., 2nd East Surrey Regiment, arrived at the depot on November 6, 1910, from Mhow. On examination he was found to be passing the *B. typhosus* in his fæces practically in pure culture. He was anæmic, and complained of pain in the gall-bladder region. He was given a thorough course of vaccine treatment, begun at the very earliest opportunity, but although he improved greatly in general health the treatment had no effect on the excretion of the bacillus, and he was invalided home in October, 1911.

TREATMENT OF CHRONIC CARRIERS.

Five chronic carriers (fæcal) were treated by repeated doses of autogenous vaccines. Of these five, two cleared up while under treatment, while three remained *in statu quo*. The two who ceased to excrete the bacillus while under treatment, one typhoid and one paratyphoid, had perhaps not been long enough after the fever to be reckoned as definite chronic carriers. One ceased three months and one six months after the fever, and therefore a spontaneous cessation could not be excluded. On the other hand, of the three who were not cured by the vaccine, treatment had been commenced in two instances within six weeks after defervescence.

Although these results are not very encouraging, still I believe it is worth while to persevere with this line of treatment, especially if the cases can be got in the early stages of the condition. At least one or more cases may be met with in which the chances for or against the man becoming a carrier are very evenly balanced, and a dose of vaccine may just determine a cure.

The opsonic index had apparently no correlation with the cessation of excretion, as in at least two instances the serum of the men who continued to excrete the bacillus gave a much higher reading than did that of the two who had been cured.

For the notes of the work in the depot at Naini Tal for 1911 the writer is indebted to Captain J. L. Wood, R.A.M.C., who took over charge in March of that year.

During the year 323 men arrived at the depot, and 285 were examined and sent down; 5,979 samples of fæces and 4,375 samples of urine were examined.

During the three years that the depot had been in action the number of examinations had been gradually increased. In the first year (1908) only the nine-inch plates were available, and two of these were used for each sample of fæces. As it was only possible to get twenty plates into the incubator, it will be understood that the examinations were limited in number. In the following year two gross of six-inch plates were received and also an incubator capable of holding eighty of these plates. At this time three plates were used for fæces and one for urine, so that twenty examinations daily were possible.

By careful calculation of the dilutions of the fæcal samples, it was possible to use only one plate for each fæcal sample and one small three-inch plate for the urine. By this means, without increasing the amount of medium expended, it was possible to increase greatly the number of examinations.

In 1911 accommodation was provided for officers convalescent from enteric fever, and five were received and examined. Quarters for women and children are also being built, but had not been completed by the end of 1911.

The cases received at the depot in 1911 were classified as follows :—

Paratyphoid fever	90
Enteric fever	95
Pyrexia of uncertain origin, suspected to be paratyphoids	138

Captain Wood divides up the typhoid cases as follows :—

Confirmed by blood culture	18
Clinically and by Widal	39
Probably paratyphoid	35
Probably neither	3
	95

Of the one hundred and thirty-eight cases sent up as pyrexia of uncertain origin, five were found on arrival to be excreting the *B. paratyphosus* A in their fæces, and one man continued to do so for more than six months after his fever; a very shrewd commentary on the risk of relying on blood culture alone for a diagnosis.

It is practically certain that if these cases had occurred two or three years earlier, before attention was directed to the paratyphoid fevers by the work done at the Naini Tal depot, they would not have been regarded as dangerous, and would have been returned to duty as soon as physically fit, with the result that numerous fresh cases would have arisen.

Amongst the cases diagnosed as enteric fever on clinical grounds plus Widal reaction, one man was found to be a temporary carrier of the *B. paratyphosus* A.

In this year (1911) *no* carriers of the typhoid bacillus were detected; but it must be remembered, as already pointed out, that convalescents from true enteric fever are not sent up to the depot until at least six weeks after their fever had ceased, and thus the majority of temporary carriers have been already eliminated.

No fewer than twelve men were found to be temporary carriers of the *B. paratyphosus* A. All, with one exception, ceased to pass the bacillus within two months of their arrival. One man was still a carrier six months after his fever. None were treated by vaccines.

WIDAL REACTIONS OF CARRIERS OF PARATYPHOID A.

		B. typhosus			*B. paratyphosus* A		
		1/20	1/40	1/100	1/10	1/20	1/40
Private C.*	..	±	∓	–	–	–	–
,, E. ..	..	±	∓	–	–	–	–
,, D.	..	∓	–	–	–	–	–
,, McK.	..	±	∓	Trace	∓	–	–
,, J. ..	..	∓	∓	±	Trace	–	–
,, S. ..	..	±	±	∓	±	∓	–
,, H.	..	±	±	∓	∓	–	–
,, Jo.	..	∓	∓	Trace	±	∓	–
,, A.	..	±	±	±	+	±	∓
,, McK.	..	±	∓	Trace	–	–	–
,, McL.	..	∓	Trace	–	–	–	–
,, C. ..	..	∓	∓	Trace	–	–	–

* A chronic carrier of paratyphoid A; the remainder temporary carriers.

These reactions were estimated on arrival at the depot. All these men had been recently inoculated against enteric fever.

During the five years 1906-1911 that the writer was engaged in work on enteric fever in India, only two fatal cases came under notice out of several hundred cases of paratyphoid fever. During the four years that the depot has been in existence, thirty carriers of bacilli of the typhoid group have been detected, and of these twenty at least might be classed as true chronic carriers. The remainder, had they been kept in hospital for at least two months from the cessation of their fever, would not have been a danger to their comrades; but as most of these men had had mild attacks of paratyphoid fever they would have been returned to barracks as soon as they were physically fit.

It may be asked, is the detection and removal of these men sufficient justification for the establishment and upkeep of the depots? The answer is undoubtedly in the affirmative. Two instances have been given in which acute carriers of the *B. paratyphosus* A gave rise to small epidemics of the disease, one man causing nine cases, the other twelve. Both these men ceased to excrete the bacillus spontaneously within a few weeks.

Had the twenty chronic carriers been allowed to remain in barracks or in camp they might quite readily have caused collectively one hundred fresh cases a year, and they would have been continually operative year after year. This calculation is based on the very moderate estimate that each carrier would cause only five fresh cases per annum, whereas one single carrier may give rise directly or indirectly to an epidemic of a hundred or more cases.

The detection of these men is a comparatively easy task,

provided that the work is in the hands of a trained worker and that there are not too many cases to deal with. To look for a carrier among a large garrison population, the majority of whom are inoculated, is one of the most difficult tasks imaginable. As a rule, one can only surmise the presence of such a person as evidenced from time to time by the appearance of fresh cases of fever. Carriers must be eliminated by the examination of all cases of fever.

The main work of the depots is not merely the detection of carriers, but lies rather in the examination of the great body of convalescents and their return to duty with a clean bill of health.

Without doubt the most dangerous person to have in an expeditionary force is the carrier, as under active service conditions his opportunities are greatest. It would be quite impossible to examine and to declare free from infection an expeditionary force of even fifty thousand men.

During peace we must prepare for war, and this is true as much of the detection of carriers as it is of the practice of musketry, &c. It must be remembered, however, that in war-time our forces may be operating in a country where enteric fever is endemic, and here we must fall back on our second line of defence, namely, protective inoculation.

Our armies of the future should be carrier-free, and at the same time protected against infection from without by inoculation. Even these precautions will not entirely exclude enteric fever, and therefore rapid and accurate diagnosis of fever on active service is essential, with the isolation of all cases of enteric fever. No man who has had enteric fever should be permitted to rejoin his unit until a thorough examination of his excreta has shown him to be non-infective. If such an examination is not possible, then the man should not be allowed to rejoin his unit while they are on active service. Better to lose the services of a few men than to run the risk of losing battalions.

To sum up, then, enteric fever in military service is caused by the presence in barracks or in camp of infected persons. The prevention lies in their detection and removal. How this has been accomplished in India it has been the purpose of this essay to show.

Note.—This paper was written in 1911-12.

A REPORT ON A BACTERIOLOGICAL INVESTIGATION OF TYPHUS FEVER DURING THE SERBIAN EPIDEMIC OF 1915.

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THE following investigations were carried out in the bacteriological laboratory attached to the British Military Sanitary Expedition to the Serbian forces.

The laboratory was established at Kragujevatz at the end of March, 1915. The material examined was obtained from the 6th and 7th Reserve Hospitals in that town. In all, some thirty cases of typhus fever were submitted to examination.

EXAMINATION OF STAINED SPECIMENS OF BLOOD.

Twenty-two cases of typhus fever were examined in this way. The great majority of these were cases in the second week of the disease, with the rash well out and with the temperature fluctuating between 102° and 104° F. A few were febrile cases in which a provisional diagnosis of typhus had been made, but in which no rash had yet appeared. These cases were examined in order to determine whether any difference existed in specimens of blood taken during the first few days of the disease.

The exact method of procedure was as follows. In all cases where a rash was present the skin over a typical typhus spot was cleansed with ether, and the epidermis scarified with a needle. Blood and serum were then made to exude; in some cases by pressure, and in others by suction by means of a small improvised suction cup. Specimens were prepared from this blood-stained serum in the following ways: In all cases one or more thick drops were taken on an ordinary slide and allowed to dry. These were subsequently hæmolysed in one per cent acetic acid, and stained by Leishman's method and also with dilute methylene-blue. In a large number of cases negative films were prepared by mixing the blood and serum with Chinese ink. In several cases ordinary spread films were also prepared and stained with Leishman's stain. In many instances ordinary blood films were obtained from some other part of the body, usually from the ear or the finger, and stained by Leishman's method.

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The blood films showed the usual leucocytosis and the high percentage of large mononuclear cells which have been observed by previous investigators. In addition to this, films from several cases showed the presence of a small proportion of polychromatophilic red cells.

In the majority of the thick-drop preparations a varying number of micro-organisms were present. In a few cases these consisted of cocci or short bacilli, but by far the most common and most constant organism was a long bacillus of the *Bacillus fusiformis* type, sometimes approximating closely to a spirillum in form. This was so frequently present that it was deemed advisable to examine control specimens from non-typhus cases.

The examination of films prepared in an exactly similar manner from eleven Serbian soldiers, suffering from gunshot and other wounds, showed this organism to be present in ten out of the eleven cases. It seemed, therefore, that it was impossible to sufficiently free the skin from micro-organisms for preparations of this type to be of value, and this method of examination was discontinued. No appearances suggesting the presence of protozoal organisms were seen.

As a point of interest it may be noted, that, in the examination of these specimens and of similar preparations from undiagnosed febrile cases, which later ran the course of a typical attack of typhus, the occurrence of a double infection with the spirillum of relapsing fever was established with some frequency.

Cultural Examination of the Blood.

Cultures were prepared from the blood in eight cases of typhus fever. The exact day of the disease on which the cultures were taken was impossible to determine since the date of onset was unknown. Each of these cases, however, was a clinically typical case with a well-marked rash, and in seven out of the eight with a temperature fluctuating between 102° and 104° F. In the remaining patient the temperature was subnormal. This was a particularly severe and acute case leading to a fatal termination in the early part of the second week, a few days after the appearance of the rash, and the blood was obtained within a few hours of death.

It may be said, however, that in all cases the cultures were taken during the second week of the disease and during the days preceding the termination of the attack by the customary rapid lysis or by death. As a matter of fact, the majority of the cases

examined in this way proved to be of a severe type and ended fatally.

The blood was obtained in all cases from the median basilic vein of the forearm. The skin over the vein was cleansed by swabbing with ether and then painting with a two per cent solution of iodine in spirit. In two cases the preliminary cleansing with ether was omitted.

A considerable number of cultures were prepared from each case. The methods employed were as follows:—

(1) *Broth.*—Aerobically and anaerobically. About one cubic centimetre of blood was added to ten cubic centimetres of ordinary broth prepared from bullock's heart and containing 0·5 per cent sodium chloride and one per cent peptone. The broth was standardized to +6 acidity on Eyre's scale, and this reaction was employed in all cases. The anaerobic cultures were put up in ordinary Buchner tubes and were not employed in all cases.

(2) *Agar.*—Aerobically and anaerobically. 0·5 cubic centimetre of blood was spread on an ordinary agar slope.

(3) *Blood Agar.*—In some cases the same procedure was carried out using agar slopes which had first been spread over with normal human blood.

(4) *Ascitic Fluid Broth.*—Aerobically and anaerobically. In a few cases 0·5 cubic centimetre of blood was added to tubes containing a mixture of two parts of broth and one part of sterile ascitic fluid.

(5) *Kidney Tissue-Ascitic Fluid Agar* (Method of Noguchi).—This was employed in all cases, about one cubic centimetre of blood being used. In five out of the eight cases the kidney tissue was obtained from rabbits, and in the remaining three from a young kitten. The cultures were covered by a layer of sterile paraffin. Controls of the ascitic fluid and kidney tissue were put up in all cases.

It is convenient to deal first with the kidney tissue-ascitic fluid agar cultures.

In two cases these remained sterile. In three cases the cultures remained apparently sterile for fourteen days. During this time, however, a gradual opacity developed in the cultures. This did not seem to be wholly explained by autolytic changes in the added blood, since a set of cultures which had been prepared in the same way from a case of relapsing fever did not show the change to anything like the same degree. At the end of the fourteen days a thin cylinder of the medium, penetrating the whole length of the culture, was removed from each tube by means

of a sterile capillary pipette and added to a tube of broth. At the same time a similar cylinder was removed from a control tube containing kidney tissue and ascitic fluid agar, but no typhus blood. All the broth tubes were then incubated. On the following day each of the three tubes, which had received material from the typhus cultures, showed a uniform cloudiness of the broth, while the broth in the control tube remained perfectly clear. This cloudiness increased on the second day and a flocculent deposit began to form at the bottom of the tube. This continued to increase in bulk while the supernatant fluid gradually cleared.

Films prepared from this deposit and stained by Gram's method or by methylene-blue showed nothing. Ordinary wet films, however, showed minute particles which suggested minute coccal or bacillary organisms. After prolonged trials, it was found that these bodies could be stained, though with difficulty, by the use of a two per cent watery solution of eosin applied for twenty minutes or longer. They then had the appearance of minute coccal or bacillary organisms when they could be separated from the large clumps in which they always occurred. These clumps themselves had an almost structureless, but obviously granular, appearance. The gradual increase in the turbidity of the medium and the formation of the plentiful flocculent deposit strongly suggested the presence of bacterial growth, while the broth in the control tube remained permanently clear, nor could any similar appearances be demonstrated in stained films prepared from it.

The experiment was repeated with a second series of broth tubes from the same cultures with identical results. All attempts to make the small organism grow on further subculture failed. In three cases cultures prepared in this way showed the presence of the cocci to be described later, and on subculturing into broth in the way described above cultures were obtained within twenty-four hours containing these cocci and also the minute pleomorphic forms.

Turning now to the broth cultures and ascitic fluid broth cultures, in every case a growth was obtained of a Gram-positive diplococcal organism. The character of the growth obtained in broth upon isolation from the body was in all cases similar. The broth above the deposit of blood was slightly cloudy, while a flocculent deposit appeared just above the blood layer and also clinging to the sides of the tube, the whole resembling the growth obtained with many streptococci. The broth just above the deposited blood was in many cases strongly tinged with hæmoglobin.

This characteristic form of growth, however, seldom persists in subculture. Growth usually first showed itself on the second day of incubation, but sometimes earlier. The organism showed a marked preference for aerobic conditions, although a slight growth was always obtained in the anaerobic tubes.

Morphologically the organism is a diplococcus, sometimes arranged in clumps, sometimes in short chains. In some cultures, and under conditions which it has up to the present been impossible to determine, it takes on an ovoid form resembling a very short stumpy bacillus. The central part of the coccus sometimes stains more lightly than the periphery. The organism in its typical coccal or ovoid form stains easily and is Gram-positive. It grows well on all ordinary media, but much better under aerobic than under anaerobic conditions. Its growth has been tested on agar gelatine (which is slowly liquefied by seven out of the eight specimens), potato, blood agar, blood serum, Dorset's egg medium, Besredka's medium, McConkey's medium, Conradi and Drigalski's medium, and in various special ways.

On agar the growth resembles rather that of a bacillus or streptococcus than that of a staphylococcus. It is somewhat translucent and has a greyish-blue tinge by transmitted light, though this typical type of growth is sometimes departed from in subculture for no obvious reason.

On McConkey's medium the growth is very slight and almost invisible to the naked eye. On Conradi and Drigalski's medium the organism grows very poorly. The colonies are at first a grey-white colour, but later take on a pinkish tinge with a corresponding discoloration of the medium.

One of the most striking characteristics, however, on all classes of media, but on some more than on others, is the appearance of forms departing widely from the original diplococcal type. If a broth culture of the organism be examined daily by making film preparations and staining them by Gram's method, using the two per cent eosin solution as a counter-stain, it will be found that within about twenty-four hours a certain number of organisms, retaining the diplococcal form but somewhat smaller than the original cocci, are present, which fail to stain by Gram's method. These Gram-negative organisms rapidly increase in number and as they do so become smaller and lose the typical coccal shape. At this stage one of the most common forms is an elongated coccus arranged in pairs and somewhat resembling the pneumococcus in shape, but of a considerably smaller size. The change progresses

and the involution forms become smaller and smaller in size and less distinct in outline. Minute coccal and minute bacillary forms are present; until, finally, a large proportion of the deposit at the bottom of the broth tube seems to consist of non-Gram-staining granular material arranged in clumps, and in which little structure can be made out with a one-twelfth oil-immersion lens.

As stated above, these small forms fail to stain by Gram's method. They equally fail to stain with such dyes as carbol-thionin or methylene-blue. They stain faintly with carbol-fuchsin and rather better with aniline gentian violet without subsequent decolorization, but the best method of staining is with the concentrated eosin solution mentioned above. These forms are, in fact, identical with the small cocco-bacillary organisms and the granular material described in the case of the Noguchi cultures.

A large number of experiments have been performed in order to determine whether these minute bodies are degeneration forms or whether they represent some active phase in the life-history of the organism. This is a question of some importance in view of the recent work of Hort and Ingram.

Of considerable interest are the results obtained by noting the changes which occur when saline suspensions of the Gram-positive diplococci are maintained at temperatures of 37° C. and 0° C. respectively.[1]

In the saline suspensions which are maintained at a temperature of 37° C., the change into the minute Gram-negative organisms takes place with great rapidity. It is well marked within twenty-four hours and almost fully developed before the third or fourth day. By this time the great majority of the organisms present consist of these minute forms. It should be noted that neither in this nor in any other case do the Gram-positive cocci ever completely disappear.

The one difference exhibited between the appearances in the saline suspensions and those obtained in broth cultures is that the large granular masses which develop in the latter are seldom or never seen in the former.

In the saline suspension kept at 0° C., on the other hand, the change is almost completely inhibited. As mentioned above the development of the minute Gram-negative forms is almost complete within a few days at 37° C. In suspensions kept for one month in

[1] I am indebted to Dr. L. S. Dudgeon for suggesting the examination of the behaviour of this organism in saline suspension.

the ice-chest only a small proportion of these forms are found, and if the suspensions are examined daily during this period only a very slight increase in the relative proportion of the small organisms is observed. All saline suspensions of the coccus seem to contain a certain number of them.

The saline suspensions which have been kept in the ice-chest and those which have been kept in the incubator show obvious differences macroscopically. The iced specimens remain cloudy for many days and only gradually clear as the bacteria are deposited in a thick sediment at the bottom of the tube. The saline suspensions which are kept at body temperature gradually become clearer without the formation of more than a trace of deposit.

In further experiments the effect was studied of allowing saline suspensions, which had previously been heated to 60° C. for thirty minutes, to incubate at 37° C. over a period of several days. Specimens of the same suspension which had not been subjected to the preliminary heating were used as controls. The results showed that suspensions of dead organisms do not undergo the alteration noted above, or at all events they undergo it only in a minimal degree. After the preliminary heating a proportion of the cocci fail to retain the gentian violet when stained by Gram's method, and a few small forms are usually found. But, at a later period, when the control suspension shows the alteration to be fully developed, no appreciable change can be noted in the killed organisms.

The rate of change occurring on different media and under different conditions has been noted in a large number of cases. In general, it may be stated that the small Gram-negative forms appear more rapidly on all media under anaerobic than under aerobic conditions. They appear somewhat more readily on blood agar than on ordinary agar. On blood serum they develop slowly. On potato at about the same rate as on agar. The difference between aerobic and anaerobic cultures and the rapidity of the change in saline suspensions would suggest that these forms tend to appear more readily when the organism is growing under unfavourable conditions. This is, however, by no means always the case. Thus, on McConkey's medium, or on the medium of Conradi and Drigalski, growth is very poor, but the small Gram-negative forms practically never appear. The most noteworthy feature displayed by the organism growing on these two media is the very great variation in size and shape of the Gram-positive coccal forms. Some are large and swollen and often ovoid rather

than spherical in shape, others being considerably smaller than normal.

Again, an attempt was made to determine what alteration in form occurred in this organism when it was grown on media possessing varying degrees of acidity or alkalinity. This was done partly in order to determine whether the Gram-positive cocci ever took on a definite bacillary shape, for reasons that will appear when the results obtained by other workers are considered.

In these experiments the organism was grown on an agar medium the reaction of which varied in different tubes from -30 to $+30$ on Eyre's scale. At both extremes of reaction the growth was very poor, but on the -30 agar none of the small forms developed, though the organism was obviously growing under very unfavourable circumstances. Moreover, it sometimes happened that in growths on agar slopes, possessing the usual reaction, the formation of minute Gram-negative forms occurred with extraordinary rapidity, so that they considerably outnumbered the normal Gram-positive forms on the second or third day, although the growth was copious and of typical naked-eye appearance.

Attempts to demonstrate the further growth or development of these small forms on subculture have so far failed. After the saline suspensions have been allowed to remain in the incubator over periods varying between ten and twenty-one days, they are found to be sterile on subculture on ordinary media, such as nutrient broth or agar. At this period film preparations show abundance of the minute forms and a small proportion of Gram-positive diplococci. Suspensions of this kind have been subcultured in a large variety of media and under aerobic and anaerobic conditions, but it has not been found possible to obtain any multiplication of the small forms. In a few cases, in which no growth occurred in broth or on agar, a growth of the Gram-positive diplococcus was obtained in tubes containing a mixture of one per cent glucose agar and ascitic fluid. Further experiments along these lines are being carried out.

In addition to the organism described above, a bacillus was isolated in two cases on blood agar, once aerobically and once anaerobically. In early cultures it appeared as a short Gram-positive bacillus, later it became longer and at the same time lost its Gram-staining. In old cultures long thread-like forms appeared and the organism became highly pleomorphic, large numbers of coccal forms putting in an appearance. These latter were Gram-positive. As this organism was only isolated on two occasions,

and as moreover it has never been possible to demonstrate the appearance of similar forms in the diplococcal cultures, it seems possible that it was an accidental contamination.

Cultural Examination of the Cerebro-spinal Fluid.

Two cases were examined in this way. One of these exhibited no meningeal symptoms; the cerebro-spinal fluid appeared perfectly normal and cultures remained sterile.

In the second case definite meningeal symptoms were present. The cerebro-spinal fluid contained a few polymorphonuclear leucocytes, though it appeared perfectly clear to the naked eye. Cultures from this fluid on human blood agar yielded on the second day a growth of the coccus described above. This organism behaved in exactly the same manner as those isolated from the blood. After several days small Gram-negative bacilli with rounded ends and with a tendency to polar staining appeared in these cultures. It was found impossible to separate the cocci and bacilli by subculture. In subcultures on ordinary agar the coccus alone developed in most cases. In stab agar or in broth cultures both forms were usually present, but the bacillus could never be obtained alone.

Cultural Examination of the Urine.

Great stress has been laid on the examination of the urine in typhus cases in recent papers by Hort and Ingram. The conditions existing during this epidemic rendered it extremely difficult to obtain sterile catheter specimens for examination, and for this reason such examinations were not undertaken.

The Relation of these Findings to those Obtained by Other Invesigators.

Only cultural results are here considered.

Since the method of obtaining cultures from considerable quantities of blood drawn from a large vein has come into vogue, a considerable number of investigators have isolated from typhus cases organisms of a coccal or cocco-bacillary form.

Wilson in 1910 obtained Gram-positive diplococci in fifteen out of thirty-three cases of typhus fever. The description which he gives of this organism, particularly as regards its growth on agar and the liquefaction of gelatine, which occurred in about half his cases, agrees rather closely with the organism described above. He makes no mention, however, of the occurrence of the minute Gram-negative form.

In one case he isolated a Gram-positive diplobacillus.

By means of agglutination reactions he demonstrated the presence of specific antibodies in the blood of typhus patients against this organism. He was inclined to believe, however, as the result of various considerations, that these organisms represented rather a secondary infection than the actual cause of the disease.

In a few cases the organisms isolated during the present investigation were tested against the serum of typhus patients and against that obtained from normal controls, but it was found that the cocci had a strong tendency to spontaneous agglutination, and that the degree of agglutination was greatly increased by the presence of normal serum, and for this reason no further tests of this kind were made.

Rabinowitsch in 1909, during an epidemic of typhus in Kieff, isolated from the blood of patients suffering from this disease a short bacillus with rounded ends and showing some degree of polar staining. These organisms grew well in broth but poorly on solid media during the early subcultures. The bacilli tended to occur in pairs lying end to end, and on some media they showed marked changes in their morphological characteristics, assuming a more ovoid form. It was necessary to take the blood between the sixth and fourteenth day of the disease. Rabinowitsch demonstrated a certain degree of agglutinating power against these organisms in the blood serum of typhus patients, though the results do not seem to have been constant.

Predtjetschensky in 1910, during an epidemic of typhus in Moscow, isolated from every case examined between the sixth and ninth day of the disease a short bacillus showing polar staining. This bacillus took on varying forms according to the culture medium on which it was grown. On agar it usually showed a diplococcal form, in broth it grew as a bacillus. It readily produced involution forms, such as ovoid forms with pointed ends and sometimes long thread forms. The bacillus was Gram-negative Gelatine was not liquefied. Agglutination reactions gave no certain results. This organism was also isolated in a few cases from the sputum of typhus patients with bronchial catarrh.

Fuerth in 1911, during an epidemic of typhus fever in Tsingtau, isolated from the blood in sixteen out of forty-two cases a very similar organism. In broth cultures it grew as a very short bacillus, mostly single, sometimes double and sometimes in short chains. At first it was Gram-positive but later tended to become Gram-negative. A large number of coccal forms were present.

After growing for a few days in broth, these organisms tended to disappear and to be replaced by small granular organisms which gave the impression of degenerating bacteria. The organism grew well on most media but best on ascitic fluid broth, as was the case also with the organism described by Rabinowitsch. Agglutination reactions were inconclusive.

Müller in 1913 isolated from the blood of five out of eleven typhus patients organisms very similar to those described above. He emphasizes the highly pleomorphic character of the bacteria, and states that they sometimes take on an almost purely coccal form when they are arranged as diplococci or in short chains. In broth there was a tendency to the formation of peculiar degeneration forms, drum-stick and dumb-bell forms and irregular masses. These were at first Gram-positive but tended to become Gram-negative. Gelatine was not liquefied.

Hort and Ingram in 1914 examined the blood in twenty-two cases of typhus fever occurring in Ireland, and state that they obtained without difficulty cultures of the diplococcal and diplobacillary organisms described above. As these organisms did not in their hands produce any observable pathogenic effect in a series of bonnet monkeys, they concluded that they were either secondary infections or harmless phases in the life-history of some previously undescribed organism. Upon examining the urine obtained from thirty cases they found during the period of fever large numbers of the diplococci and diplobacilli described above. They also noted in fresh specimens of urine the presence of minute organisms which occurred singly or in pairs or in clusters. They were sometimes coccal in form, sometimes bacillary, and it was often impossible to determine whether they were coccal or bacillary. They were both Gram-positive and Gram-negative in the same clusters. They rapidly disappeared when the urine was incubated and after a few hours only the large cocco-bacillary forms could be found. After filtration of the urine through Berkefeld candles the small cocco-bacillary forms were obtained alone. When, however, this filtrate was incubated these forms quickly disappeared, their place being taken by the larger coccal and bacillary organisms. Similar findings were obtained in the urine obtained from bonnet monkeys successfully inoculated with human typhus blood. By inoculation of human blood agar with the fresh filtrate of human typhus urine, cultures of the small organism were obtained, which on subculture became mixed with the larger forms. Injection of the first culture on human blood agar into two bonnet monkeys gave rise to a high

continued fever after the lapse of a definite incubation period of a few days. This small organism was also found to be present in the cerebro-spinal fluid of typhus cases, but on incubation it was soon replaced by the large cocco-bacillary form. From fresh human typhus blood and from fresh cerebro-spinal fluid the small cocco-bacillus could be cultivated on human blood agar. (It is not stated whether these cultures were pure.)

Silberberg, in 1912, found a micrococcus in the cerebro-spinal fluid of typhus patients. This was marked by its pleomorphous character and by the fact that it constantly showed a light-staining middle part.

It must be noted that a large number of investigators have failed to obtain any growth in cultures obtained from typhus blood.

It is obvious that these investigations have led to the isolation of organisms possessing striking similarities. The question of the specific relation of any or all of them to typhus fever cannot be said to have been determined, but the results show that organisms of a similar type have been isolated from outbreaks occurring in different parts of the world which have been studied by different observers. Whether the organisms represent a harmless phase in the life-history of a highly changeable organism, as suggested by Hort and Ingram, is a question which needs further investigation.

It would seem probable at least that the small organisms which they describe are identical with those obtained during the course of the present investigation, though a point of difference occurs in the Gram-staining. Hort and Ingram's small cocco-bacilli are stated to be both Gram-positive and Gram-negative, while those isolated during the present investigation were almost entirely Gram-negative, and indeed were extremely difficult to stain at all, though it is true that in some cases, where the change from the large to the small organisms had not proceeded far, forms staining faintly with the gentian violet were obtained. It seems probable too, that both these small organisms are related to the so-called degeneration forms of Fuerth, of Predtjetschensky, and of Müller. Whether these small organisms are in truth degeneration forms can only be determined by further investigation. Their mode of appearance, their rapid production in saline solution, and the great difficulty experienced in their staining, would seem to support this view. Moreover, all attempts to subcultivate them have failed, so far as the present investigation is concerned. On the other hand, the results obtained with the Noguchi cultures seem definitely to show

that under certain circumstances they are capable of multiplication and growth. The results obtained by Hort and Ingram would tend to support the view that they are special forms of the organism rather than the result of degeneration, if we may assume the identity of the two organisms.

The recent publications of Plotz, both alone and in conjunction with Olitsky and Baehr, have introduced an entirely new factor into the bacteriological study of typhus fever. As the result of these investigations a very strong case is made out for the causal relationship towards this disease of a small Gram-positive bacillus, which is a strict anaerobe, though in Plotz's earlier communication it was stated that the organism would grow aerobically on subculture. The organism is stated to be a small pleomorphic Gram-positive bacillus, and coccal forms are said to be of fairly frequent occurrence, while polar staining sometimes occurs. It will be seen that the morphological characteristics of this organism bear several striking resemblances to those described by the investigators whose results have been noted above; but, in view of its marked peculiarities as regards cultivation, it seems most unlikely that it bears any relation to the organisms which have been previously described. Plotz himself is especially emphatic on this point. It must however be noted that Plotz only studied eight cases of epidemic typhus fever, from all of which, however, the bacillus was isolated. The majority of his observations were made on cases of the endemic febrile disease occurring in certain parts of the United States, which Brill had shown to be identical with mild cases of European typhus. The isolation of this organism from monkeys inoculated with typhus blood, and the large series of complement-fixation tests, which Plotz and his co-workers have carried out, must be regarded as pointing strongly to this organism as the causative factor in the disease.

In three cases Plotz isolated this organism by the use of Noguchi's method of cultivation. In all the eight cases studied in the present investigation, the blood was cultivated by this method, without ever obtaining a growth of the organism described by him. Too much stress should not, however, be laid on this point, since Plotz found that a medium consisting of glucose agar and ascitic fluid was far more favourable, and since his method of cultivation had not then been published, this medium was not employed. Moreover, the very varying suitability of different specimens of ascitic fluid for cultivations of this type is well known.

It is, of course, possible that Plotz's organism represents a phase

in the life-history of some exceptionally pleomorphic bacterium, but no organism presenting such very varied characteristics is yet known.

Experiments are being carried out in order to test such a possibility, and also to determine the pathogenicity for laboratory animals of the organism isolated in the course of the present investigation.

I should wish to express my appreciation to Colonel Hunter, A.M.S., and to Lieutenant-Colonel Stammers, R.A.M.C., for the kindly interest which they showed throughout this investigation.

I am greatly indebted to Colonel Gentitch and to Majors Protitch and Antitch of the Serbian Medical Service, for their kindness in supplying me with various materials for use in my laboratory, also to Captain Copshje, in charge of the 6th and 7th Reserve Hospitals at Kragujevatz, for permission to obtain material from the cases under his charge, to the doctors of the Scottish Women's Hospital who formed the staff of these two institutions, and to various officers of our party who assisted me in obtaining specimens for examination. Especially am I indebted for his invaluable help to Lieutenant McCall Smith, who acted throughout as my assistant.

I must also thank Drs. Rosher and Platts, my assistants at Charing Cross Hospital, for the help which they have given me since my return.

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Clinical and other Notes.

A NOTE ON CAMP SANITATION.

By Major A. H. SAFFORD.
Royal Army Medical Corps.

The following simple methods of preventing fly infection from latrines which have been adopted, but which do not seem to be in general use, may be of assistance to officers of the Corps.

(1) Destruction of fouled paper in latrine pans and shallow trenches. The sanitary orderlies go round the latrines with a box of matches and set a light to the paper in each pan or shallow trench three times daily at 9 a.m., 2 p.m. and 6 p.m. It has the following advantages: (*a*) The fæcal matter on the paper is destroyed and consequently cannot infect flies; (*b*) the bulk of material in the pan is considerably reduced; (*c*) the sides of the pan are sterilized; (*d*) fouled paper is not blown about the camp. There is no danger of setting light to the latrine seat.

(2) One gallon cresol solution (quarter ounce to the gallon) is used in each latrine pan. This strength is sufficient to repel the fly, and any stronger solution is therefore unnecessary, as whatever strength is used the fæcal mass will not be sterilized. If less solution is used the fæcal mass will rise above the surface of the fluid and be exposed instead of the fluid rising above the fæces.

If these two methods are combined, there is no possibility of fly infection from the latrines.

BLOOD CULTURES *V.* CLINICAL DIAGNOSIS.

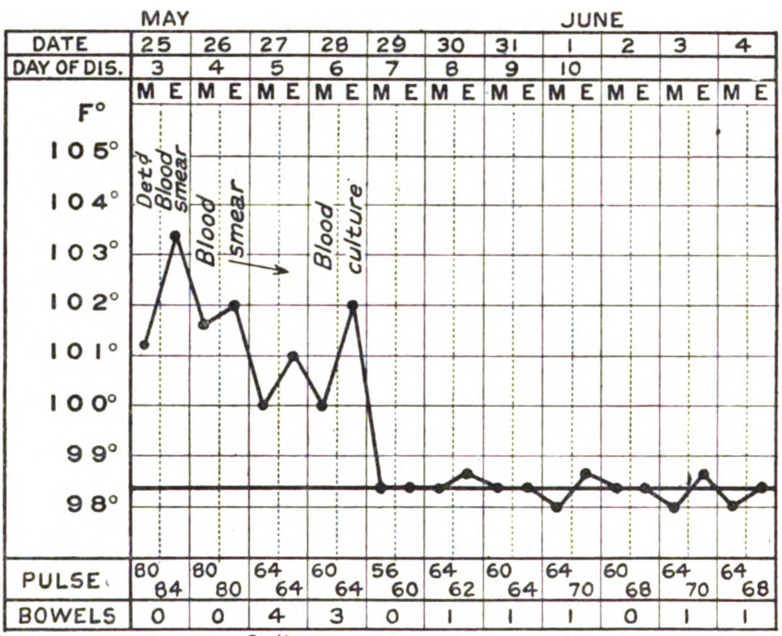
By Lieutenant-Colonel F. C. HEFFERNAN
and
Major F. A. H. CLARKE.
Royal Army Medical Corps.

Private R., belonging to a Territorial Infantry unit in Mhow, and recently returned from a visit to Delhi and Agra, was admitted to hospital, having been detained on the previous day. He complained of headache of three days' duration, pain, exaggerated on movement, in the eyeballs, a dull aching pain in the loins, and pains in the knee-joints. There was slight constipation, tongue thinly furred, eyes injected, and face flushed. Temperature on admission 101·8° F., pulse 80. Respiratory and circulatory systems normal, and no abdominal pain nor distension. Blood smears examined for malaria were negative on two occasions.

The treatment was mainly symptomatic, and the symptoms cleared up

on the day after admission, when the temperature fell to 100° F. and a papular rash appeared on the chest. The next day the temperature rose in the evening to 102° F., falling to normal by crisis the following morning and remaining so.

Convalescence was uninterrupted, and the patient was, to all intents and purposes, well and fit for duty within a week. A blood culture taken on the third day in hospital had in the meanwhile, on examination in the Divisional Laboratory, given the reactions of paratyphoid A, and these were subsequently confirmed at the Enteric Convalescent Depot at Naini Tal.



From a glance at the temperature chart it will be seen that it is a typical one of dengue, and the symptoms were characteristic of that disease in a mild form. There was an entire absence of anything that would direct one's attention to the abdomen, the patient had been fully inoculated six months previously, and the case, up to the time of receipt of the laboratory report, was believed to be one of dengue. The blood culture was made only because it is a routine measure in this station, and not because the case was regarded at any time as suspicious.

Our apology for reporting this trivial case lies in the fact that, in the absence of a positive finding in the blood, this man would have been at his duty within ten days of his last day of fever. The potentialities of cases similar to this, as a possible cause of the spread of disease, cannot

be overstated, and for this reason it is urged that the fullest advantage should be taken by medical officers of the facilities which exist for the examination of blood cultures in a laboratory.

We are indebted to Captain P. Hayes, R.A.M.C., in whose care the case was, for kindly giving us the clinical details.

CASE OF SIMULTANEOUS BILATERAL FRACTURE OF PATELLÆ BY MUSCULAR TRACTION.

By Temporary Lieutenant J. ANDERSON, M.B., Ch.B.
Royal Army Medical Corps.

As this case is unique the following particulars are given :—

Driver J. C. A., aged 31, was admitted to the Connaught Hospital, Aldershot, on June 20, 1915, with obvious fracture of both patellæ. He stated he was practising for regimental sports, and that at the time of the accident he was engaged in "hop, step and leap." At the "hop" he stepped off on his right foot and as he landed he felt the right knee-cap give way. At the moment the left foot touched the ground the left patella also gave. At the time the accident occurred he heard "two cracks," one immediately after the other, and the sound he likened to the breaking of pieces of "dry wood." This occurred before either knee touched the ground. The soil was soft sand, and there were no stones to fall on as the track had been specially prepared. He had no pain immediately after the accident, but could not rise from the ground.

The clinical picture was the usual one found in such a condition, with considerable interval between the fragment. There is no family or previous history of bone disease, and patient is a healthy muscular man with large frame.

X-ray examination showed: *Left side*, simple transverse fracture. *Right side*, a three-fragment fracture.

Treatment.—Transverse wiring.

Unusual points which justify record :—

(1) Almost simultaneous bilateral fractures by indirect violence.

(2) On one side the fracture was multiple.

CASE OF LAMINECTOMY, LUMBAR REGION.

By Captain G. G. TABUTEAU.
Royal Army Medical Corps.

Patient, Private T., admitted to No. 1 Stationary Hospital, April 29, 1915, suffering from gunshot wound of back. There was a circular entry wound apparently caused by a shrapnel bullet, in the left loin above the posterior superior iliac spine. No exit wound. He had been wounded four days previously. Condition on admission: Temperature 100° F., pulse 88, respirations 20. Complete paralysis from the umbilicus

downwards. Plantar, patellar and inferior abdominal reflexes absent. Sense of touch and pain present and unaltered. Loss of function of bladder and rectum. Urine very strongly alkaline and containing much thick ropy pus. Bladder distended to umbilicus on admission. Urine contained much blood on withdrawal. Regular catheterization required. Bowels relieved by enemata. X-ray examination showed a full shrapnel bullet lying in the lumbar region just to the left of the mid-line, apparently between the fourth and fifth lumbar spines. The bullet was localized by MacKenzie Davidson's method. Urotropine, ten grains, administered four-hourly.

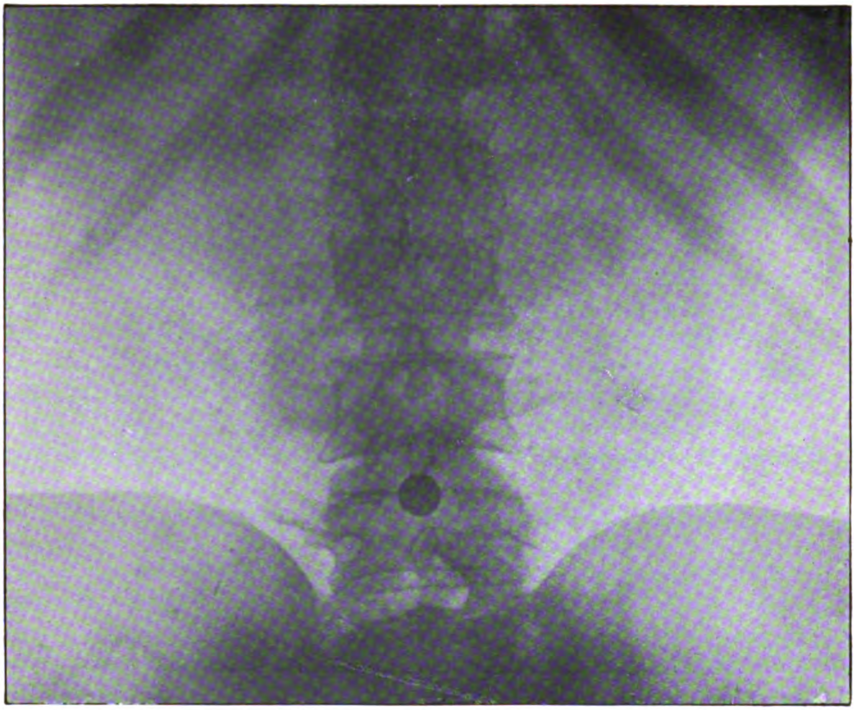
Operation, May 2, 1915.—Morphia quarter grain, with atropine one one-hundredth grain, was administered hypodermically one hour before operation. Anæsthetic used, ethyl chloride and ether. The lumbar muscles were fully infiltrated with adrenalin chloride and novocain. A vertical incision was made slightly to the left of the middle line, and the muscles separated from their attachments and retracted outwards. Owing to the free use of the adrenalin injection before the operation, hæmorrhage from the muscles was *nil*. The spinous processes of the fourth and fifth lumbar vertebræ were chiselled away, then the left lamina of the fourth vertebra was removed. On opening the spinal canal no hæmorrhage was found and the bullet was seen to be lying loose in the canal, from whence it was removed with ease. The wound was closed with catgut sutures through the lumbar fascia, and with silkworm gut sutures for the remainder. A drainage-tube was left in the lower angle of the wound reaching to the vertebra. Patient bore the operation very well. Owing to the use of morphia and the infiltration of the muscles with adrenalin and novocain, very little general anæsthetic was required. Patient complained of pain in the back during the night, which was relieved by hypodermic injections of morphia quarter grain. He was dressed daily. Tube removed on the fourth day. Stitches removed on the ninth day. The wound healed by primary union. Temperature and pulse normal. Bladder condition continued very troublesome. A soft rubber catheter was tied in on May 5, 1915, and the bladder washed out twice daily with boric lotion.

May 8, 1915.—Pus in urine much less. There is some slight return of power in the legs, chiefly in the left. Bowels still have to be relieved by enemata. Complains of pain down the right thigh and leg during the night, which required the administration of one-sixth grain of morphia.

May 11, 1915.—Movement of legs much the same. Still complains of pain.

May 18, 1915.—During the previous week patient's temperature has been ranging between 99° and 100° F. There is no definite cause to be seen. Movements of limbs very much improved.

May 25, 1915.—Patient passed urine naturally for the first time. Practically full muscular power of the legs now present, and does not



To illustrate "Case of Laminectomy, Lumbar Region," by Captain G. G. TABUTEAU, R.A.M.C.

complain of any pain. Legs are considerably wasted, probably partly from disuse and partly from the spinal injury.

May 27, 1915.—Patient allowed up in a chair.

May 30, 1915.—Patient now walking with assistance.

June 3, 1915.—Improvement continues. Had a slight rise of temperature the previous night. Bladder and urine normal.

June 6, 1915.—Patient transferred to England. Pulse, temperature, muscle power, and bladder and rectum normal.

I am indebted to Lieutenant W. F. Neil, R.A.M.C., for his assistance during the operation, and to Corporal F. Martin, R.A.M.C., for the skiagraphy of the case.

REGIMENTAL MEDICAL AID IN TRENCH WARFARE.

By Colonel W. W. PIKE, D.S.O.

This, at all times a very difficult subject, has become more so by the use of high explosive shells by the enemy.

(1) The position of the medical officer and aid post in trench warfare should be about half a mile back; the aid post should have good cover, when possible in the cellar of a building or in a well-constructed dug-out and near a communication trench leading up to the front trenches. (i) Slight cases can be *directed* to this aid post; (ii) more severe cases *brought* to it by stretcher-bearers after the first field dressing has been applied; (iii) the medical officer can be *sent for* if any extra severe cases occur.

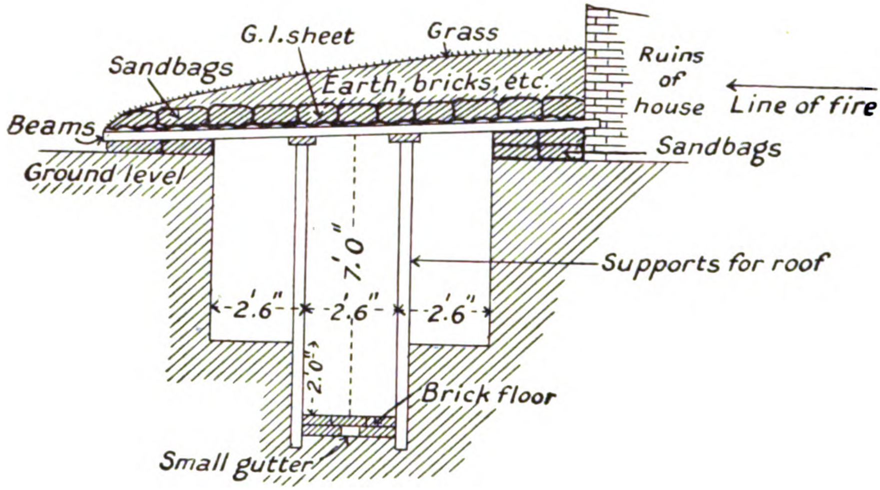
(2) The above position and conditions would be ideal, but are seldom obtainable.

The above was the introduction and the first two paragraphs of a circular sent out by me to all the medical officers in the Indian Corps, in which I asked for any suggestions officers would like to put forward. The response was very satisfactory, and I am particularly pleased at the clear opinions brought forward by many of the younger officers, showing that they have thought out and grasped the difficult problem which is the subject of this article.

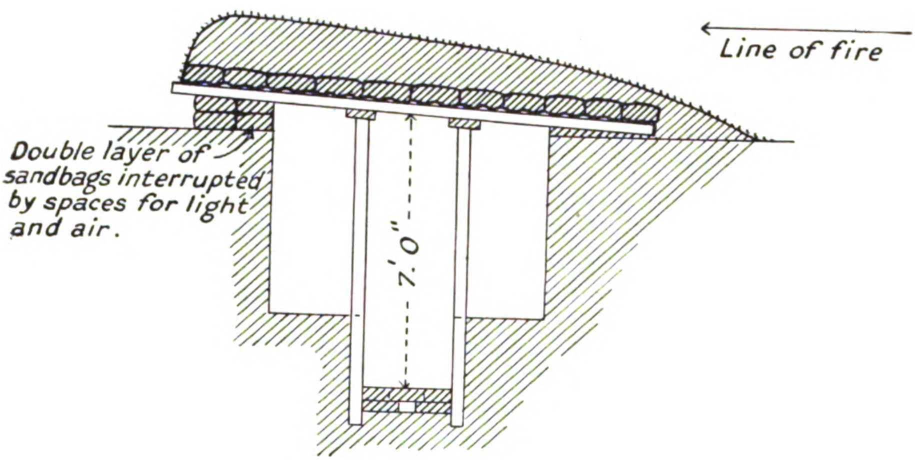
A consensus of opinion is in favour of the position above stated.

I will consider the subject under the following headings:—

(1) Position of aid post and medical officer.
(2) Equipment—(*a*) aid post, (*b*) medical officer, (*c*) stretcher-bearer.
(3) Personnel of aid post.
(4) Evacuation, to and from aid post.
(5) Forms and arrangement of the dug-out.
(6) Combined aid posts.
(7) Advanced dressing stations.

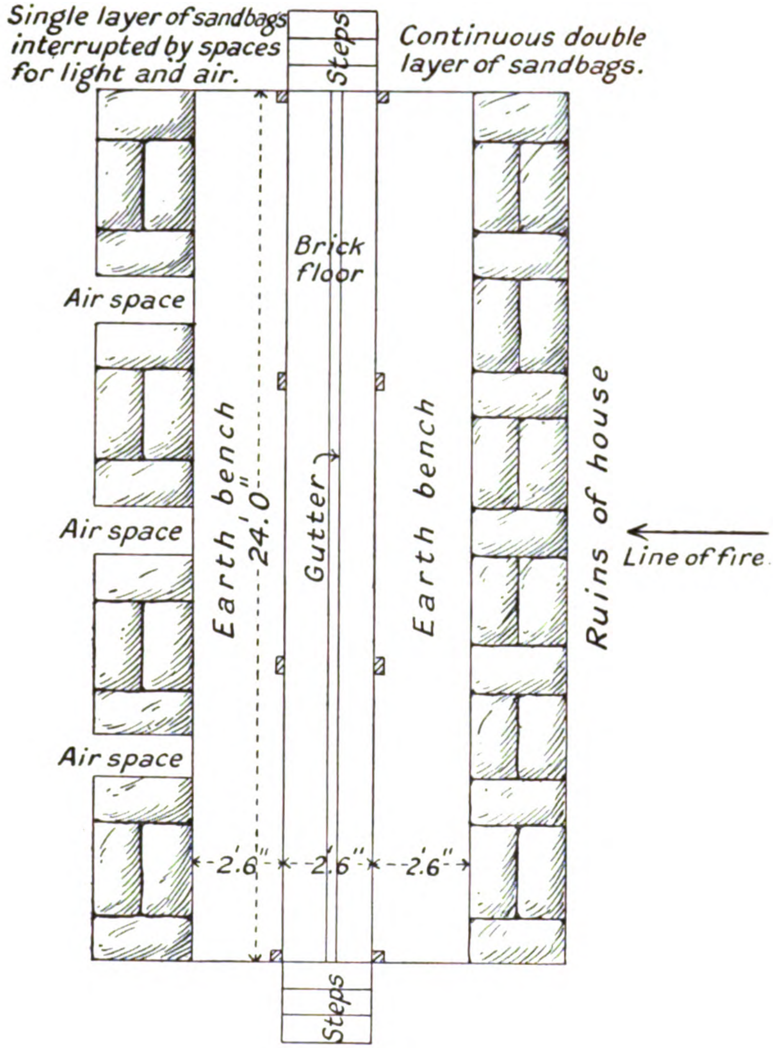


A.—End view.



C.—End view.

NOTE ON C.—If in the open the roof must slope this way, the edge next the enemy resting directly ON the ground, and being well banked over with sandbags, bricks, and earth.



B.—Plan.

(1) Position of Aid Post.

This should be near the regimental headquarters, for the following reasons: (*a*) It is generally a good central position; (*b*) by being with the commanding officer the medical officer is at once informed of all important occurrences and he can act quickly; (*c*) he can be at once called by telephone to any part of the trench line should necessity arise; (*d*) he will be near the commencement of a communication trench; (*e*) he can do his daily sanitary inspections easily and fairly safely (his daily

visit has a good effect on the *moral* of the troops and the sanitary orderlies work better); (*f*) should he require more bearers, or a specially large number of cases require evacuating, he will be on the telephone to Brigade Headquarters, which should be connected up with the advanced dressing station; (*g*) *any* case can now be brought back through the communication trench on a "Rogers" trench stretcher, four of which (owing to the kindness of the committee of the "Indian Soldiers' Fund") I shall shortly be able to issue to every regiment in the Indian Corps; (*h*) the "carry" for the regimental stretcher-bearers would be short and (owing to arrangements *re* personnel, to be mentioned later) they should not go in the rear of the aid post; (*i*) in trench warfare one aid post is sufficient per unit, and often one is sufficient for two or more units (*see* combined aid posts).

(2) EQUIPMENT.

(*a*) *Aid Post.*—This contains a pair of panniers and a water-bottle, with either a field companion or surgical haversack, and a supply of shell dressings, also iodine and ampoules of ammonia for gas poisoning, means for heating water, milk, or beef-tea, and half-a-dozen blankets.

(*b*) *Medical Officer* should have his pocket case, iodine, morphine, and a few extra first field dressings in his haversack.

(*c*) *The Stretcher-bearers* should each have six first field dressings, a couple of shell dressings, and a small bottle of iodine with brush in a haversack. The non-commissioned officer or senior bearer carries the field companion or surgical haversack (whichever is not left at the aid post). Iodine should be applied to *all* wounds. One officer suggested that each bearer should have a pair of scissors for cutting off clothes, but this should be done *very* rarely, as cold adds to shock, and when necessary the pocket knife is just as handy. Medical officers and stretcher-bearers should invariably use the patient's first field dressing when suitable first, as in the majority of cases I have seen the wound has been dressed with dressings from the surgical haversack or field companion or the stock carried by the stretcher-bearers; the patient's first field dressing being in his pocket is forgotten. This is sheer waste which it is most important to avoid.

The medical officer must, by careful study of the trench map, know the exact lie and all about the trenches of his unit, and the troops must accurately know where the aid post is and its position with relation to the communication trenches.

(3) PERSONNEL OF AID POST.

A medical officer, assistant or sub-assistant surgeon (or non-commissioned officer in British formations), orderlies, ward servants, etc.; *each aid post should have four to six bearers, with two stretchers, attached to it from the advanced dressing station (or more if a heavy engagement is expected).*

(4) Evacuation.

The case should be evacuated, by communication trench, to the aid post *as soon as possible* after being wounded either walking or carried on a "Rogers" trench stretcher by stretcher-bearers of the unit.

After being attended to by the medical officer, the case should be evacuated from the aid post *as soon as possible* to the advanced dressing station walking, or by ordinary or "Rogers" stretcher carried by bearers lent by the advanced dressing station. These bearers should return or be replaced at once and bring back the stretchers, or others in place of them.

Evacuation should go on at all times when possible; usually it can be carried out more safely by day than by night, and the stream from the fire trenches to the aid posts, advanced dressing stations, field ambulances, and on by motor ambulance convoys to casualty clearing stations should be constant. There will be stoppages owing to severe bombardments, hostile infantry attacks, etc., but then the movement must be re-started at the earliest possible moment.

We have a most excellent method in the Indian Corps of evacuation from aid posts to advanced dressing stations which I can show to any officer who wishes to see it, but which it would be inadvisable to publish in this article.

(5) Forms of Aid Post (*see* sketches, pp. 234, 235).

Houses when possible, but good cellars or dug-outs to go into if shelled, are indispensable. If there is no house standing, a dug-out close behind a ruined house is the most satisfactory, and the cellar may possibly be used also.

Dug-outs are of all kinds and shapes, and must of necessity vary greatly. One of the best, which is capable of sheltering (except from *direct* shell fire) thirty sitting cases or six lying on stretchers (or, of course, a proportion of each), requires the following dimensions, and should be dug the same shape as nearly as possible as the inside of an omnibus: width 7 ft. 6 in., depth 5 ft. to 7 ft.—the nearer the latter figure the better, as it is terribly fatiguing to work in a stooping position—length 24 ft., entrance 2 ft. 6 in. wide in the centre of one end, exit at the other by steps cut in the clay and not too steep. The seats should be 2 ft. 6 in. wide and the same height, the middle space the same width, *i.e.*, 2 ft. 6 in. It is advisable to lay boards (if available) or bricks on the floor. The roof should be made of beams supporting sheet iron covered with sandbags and earth to a depth of at least 2 ft. or more, and if bricks are put in as well all the better. The sheet iron should have enough slant not to lodge water. This may be effected by placing the side next the enemy on a double row of sandbags and the other side on an interrupted row of single sandbags—the interruptions allow air and a certain amount of light to enter at the side distant from the enemy. If not protected by the remains of a house

the higher side should be away from the enemy and the lower side, resting on the ground, "banked over" with sandbags and earth and covered with grass. Grass seeds might be planted on the top, or the whole might be turfed over.

The dug-out can be made any size, but the 24 ft. size seems best, and if more accommodation is needed a second can be made, which should communicate with the first. Other dug-outs should be made for the medical officer and personnel.

One medical officer, a Captain, of the Royal Army Medical Corps, has a special dug-out for detained men, and estimates that about seventy to eighty men were kept with the regiment monthly by this means who would otherwise have gone to hospital and been away a long time; this is a point worth considering.

All aid posts, whether dug-outs or houses, should be permanent and handed over on relief from unit to unit as *aid posts*.

(6) Combined Aid Posts.

In the present system of trench warfare it is usual for several regiments to hold a fairly short front, and the number of sites being limited an aid post is often formed with the medical personnel of several regiments in one place. This is, in my opinion, a most excellent plan; it enables medical officers (*a*) to relieve each other for rest; (*b*) to aid each other in operations; (*c*) to visit their front trenches and make sanitary inspections frequently and still have a medical officer in the aid post, as, of course, these visits and inspections should be made at different times, one medical officer being left at the aid post during the absence of the others. Under these circumstances one medical officer could be in the front trench for twelve hours at a time.

I am entirely in favour of these combined aid posts when at all possible, and there should be no chance of friction if separate dug-outs are used for the patients and personnel of units. Medical officers should share a dug-out.

(7) Advanced Dressing Stations.

These should be (*a*) in a fairly safe place, (*b*) a house if at all possible, with good dug-outs for use if shelled, (*c*) on a good road which is sufficiently under cover to allow of *constant* evacuation with a minimum of risk from shell fire, (*d*) in telephonic communication with Brigade and Divisional Headquarters, and so capable of telephoning to any aid post.

They should have, in addition to the usual drugs and equipment, oxygen and an apparatus for administering it, wheeled stretcher-carriers, spare stretchers, blankets, hot-water bottles, etc., and also one or more motor ambulance wagons, which as soon as filled start off for the field ambulances.

A FEW NOTES ON MILITARY RADIOGRAPHY IN THE ENGLISH HOSPITALS IN FRANCE, DURING THE FIRST NINE MONTHS OF THE WAR.

By CLAUDE GOULDESBROUGH, M.B.

Senior Consulting Radiographer to the British Expeditionary Force; Assistant Superintendent to the Electrical Department, St. Thomas's Hospital.

The following description and remarks refer not only to the numerous Royal Army Medical Corps hospitals proper, but also to the hospitals sent out by the various Voluntary Aid Associations, namely, the British Red Cross Society and the St. John's Ambulance Association, which, however, as regards control are under the direction of the Military Authorities.

The period under review naturally divides itself into two distinct parts, namely, the first four months (roughly), during which time, owing to the rapid changes in position of the combatants, hospital arrangements were necessarily of a temporary character, and the present period, dating from the establishment of two opposing lines stretching from the Channel coast to the Swiss boundary, during which time the hospitals have been able to be thoroughly organized at their respective bases. It must be understood that the field ambulances are not equipped with X-ray installations, but arrangements are being made to supply them with the assistance of radiography on the few occasions it is required.

From the end of August to the beginning of November a great number of wounded were being sent to Rouen and Paris, particularly the latter, as Rouen had not yet developed into the large hospital base it is at present. I was then in charge of the radiographic department at the British Red Cross Hospital at Paris (an auxiliary). I had brought with me from England my own portable outfit, and to this was presently added a permanent plant, the property of the British Red Cross Society. Owing to the fact that at first there were no other English X-ray machines out in Paris, the work was fairly strenuous, but by aid of a French assistant, M. Guy, and a very intelligent orderly, this hospital was relied on to do X-ray work not only for the other English and some French hospitals in Paris, but also for the places outside Paris as well, within a fair radius. For this purpose the portable apparatus was put in a car and taken where required, accompanied by one radiographer and orderly; meanwhile the other attended to the hospital proper. It must be stated that although the Gaiffe installation at the hospital was of the most perfect description, nevertheless the work which was done with the portable coil and thirty-six volt accumulators was just as good, if not better, than the work turned out at the hospital. This was of course due to the fact that one was working outside with an apparatus with which one was quite familiar, and points to the well-known fact that it is very difficult to produce at once perfect results when apparatus and tubes, etc., are new.

With the portable apparatus nearly every class of case could be satisfactorily dealt with from the radiographic point of view; but it was when it came to the question of screen examinations (hunting for the track of bullets, etc.), and accurate localization, that the want of the more elaborate installation was felt.

As a result of the work performed under these conditions it became evident that one of the most important factors in connection with military radiography was the possession of a portable outfit in connection with every installation, by which is meant the ability to be able to carry the apparatus to the bedside of those patients who are too ill to be moved, and it was surprising to find what a number of cases there were which could not be, or ought not to be, moved from their beds for this purpose.

Consequently later on, when it became necessary to advise concerning the radiographic arrangements at various places in France, one of the most important and difficult problems was the question of devising schemes to suit each individual requirement by means of which this necessity could be overcome.

During this first period, therefore, such radiographic work as was performed was done mainly by portable apparatus, the developing, etc., being carried out in tents, in which also the apparatus was kept. Now X-ray work under these conditions was extremely difficult to perform satisfactorily, owing to lack of proper facilities for washing, etc., to mention one factor only.

Certain deficiences in the existing standard War Office outfit, which could not have been foreseen, were also making themselves felt, the two main points being the difficulty of performing both a screen and a plate examination successively without disturbing the patient, and the septic nature of nearly all the wounds (which factor I gather from surgeons who were at the South African War had not been anticipated). As a consequence of this sepsis and the severity of some of the injuries, which it was impossible to have foreseen when the apparatus was devised, the result was that the radiographic table was in need of considerable modification. A third factor also was that the missiles, particularly bullets, were found to track considerable distances from their entry wounds, and consequently plates exposed in the vicinity of the seat of injury very frequently failed to reveal the foreign body. The most popular modern method of radiography for ordinary hospital and consulting practice has been to suspend the tube above the table, and placing the plate underneath the patient, to allow the rays to pass from above downwards. The advantages of this method, when practicable, are (1) quickness, (2) ease of manipulation, (3) almost complete protection against injury from the rays for the operator, and (4) less risk to the patient than when the damaged portion of body has first to be sought for and centred on the screen—the plate being subsequently substituted for the latter.

This method, however, for reasons already stated, proved impracticable, and so a new couch was devised, in which the tube was placed below the table, and the screen and plate-holder above, so that the rays passed first through the couch, then through the body before reaching the plate or screen. This is an old method revised.

The obvious disadvantages of this method, namely, risk of "burning," difficulty of rapid movement of tube, and unsteadiness of the plate, were minimized, in the first place, by protective devices (all operators were instructed to wear protective aprons and gloves), and more or less overcome in the other cases by mechanical additions to the table, by means of which the plate and screen could be easily snbstituted for each other in a holder, the distance of which from the tube was known. Stereoscopic negatives and accurate localizations could easily be obtained. This has proved to be the most practicable method of dealing with the routine of military skiagraphy. A short account of the method adopted in searching for and localizing a "foreign body" may not be out of place.

The patient is carried into the X-ray room on a stretcher, which is placed on the table. The poles and end pieces of the stretcher are then withdrawn, leaving the patient on the canvas of the stretcher. Previous to this the entrance wound has been marked by placing a piece of coiled wire just on top of the dressing, underneath the bandages. The room is then darkened, and the tube moved about until the image of the missile is seen on the screen. The iris diaphragm is then closed, until the image of the "foreign body" is accurately in the centre. The diaphragm is then opened as much as is required, and, as the tube also has previously been centred in the tube box, it is only necessary to read off on the upright pillar the distance of the tube from the screen in order to be able to carry out the combined method of stereoscopic and simple distance reading localization, which is usually adopted. This is done as follows: The tube box is shifted from the centre three centimetres, and a plate taken, then three centimetres from the centre the other way, and a second plate taken. The two plates are subsequently compared and the displacement of the two shadows transferred to a piece of transparent celluloid or paper. The negatives themselves are examined in the new type of portable stereoscope, the advantage of which is that it can easily be carried into the operating room, which in nearly every hospital is now supplied with electric light, and being placed on a small table by the surgeon's side can be referred to when required. The actual distance of the bullet from the surface can be ascertained from the measurements taken, either by means of the Mackenzie Davidson localizer, which gives the position in all three dimensions of space, or by the simpler method of a modification of Hampson's localizer, which hangs on the wall of the X-ray room, and is manipulated by merely adjusting the position of two strings attached to slides, and which gives the position of the "foreign body" in one dimension of space in a few seconds.

There has been a considerable discussion during this War as to the advantages and disadvantages of the various methods of localization as practised by various radiographers, the character of the arguments implying rather that the main object and end of the radiographical examination is the ability to be able to state to the surgeon the exact distance in inches or millimetres of the "foreign body" below any known surface marking. No doubt in some cases, especially in brain surgery, this information is of great value, but there is a tendency for its importance to be exaggerated, especially as nearly every surgeon has his own pet method of localization, which he wishes the radiographer to carry out, and this unfortunate man is supposed to have at his fingers' ends Brown's modification of Smith's method, etc., for the use of the surgeon interested. It was manifestly impossible for the radiographers to be completely *au fait* with all these methods, and so the standard method already described was adopted. The Mackenzie Davidson method, excellent as it is and indispensable in eye cases, etc., was found to take up too much time and to be too delicate for routine work, and so the modification of Hampson's method already described was adopted.

Now as regards some details of the actual arrangements for producing the high potential current necessary for lighting up the tube. The coil in every radiographic outfit is designed to work under four different conditions, i.e., 220 and 100 volts, shunt and accumulators. Now a coil constructed on this compromise principle can never be quite as efficient as one made to work for any one particular voltage, but it was thought advisable to adopt this plan in order to be able to use the main town current. In towns like Boulogne, which have a direct current supply, this arrangement was admirable, but in most other French towns an alternating current was the rule, and consequently an arrangement had to be thought out by means of which the alternating could be turned into direct current. Various schemes were considered, and eventually an alternating current break was adopted in one of the hospitals at Rouen, and has proved such a success that its adoption in all the camp hospitals at Rouen has been recommended. A word of explanation is here necessary.

All the outfits are supplied with accumulators of 36 volts, and a petrol dynamo engine set for charging them. Now, the power given out by the coil under these circumstances, i.e., with the accumulators, was sufficient, with rather long exposures, to radiograph every part of the body, but it rendered the performance of screen examinations very difficult, and so in order to reduce the time of exposure and to render radioscopy easier, the installation of an alternating current break was adapted, this method doubling or trebling the output from the tube at very little extra cost and causing considerable saving of trouble.

The original coils sent out at the beginning of the War had necessarily suffered much rough treatment, especially during the "retreat," and so

it was not surprising to find that some of them had partially or completely broken down, but taking things as a whole the apparatus has withstood the rough knocking about very well, and at the end of May all the apparatus at Rouen, the last base visited, was in good working order.

Just a word about the hospitals near the fighting line. These hospitals evacuate so fast that in most cases X-rays are not needed, and there are military reasons, I believe, why permanent installations are undesirable. But there are undoubtedly occasions when some form of radiography would be of great advantage, for instance, when performing brain operations on a case when the presence of fragments of shell, &c., is suspected, but not known. Consequently, a mobile X-ray unit, a present from the Ladies' School at Cheltenham, in the form of a motor lorry, completely equipped with everything necessary in the radiographical line, has been sent up to the Front in charge of Lieutenant Lang, who is responsible for designing and fitting out this car.

During the last few months the various installations have been erected in rooms adjoining or as near as possible to the operating theatre. In some cases when the hospital has been a hotel or disused house, this has been impossible, and the quarters necessarily in some cases are very cramped. In places where the hospitals are in huts a very fine accommodation for the X-ray plant has been provided next to the operating room. The personnel consists as a rule of a lieutenant in charge, who may or may not have beds to look after as well, and one or two orderlies. The surgeons, as a rule, prefer to examine the plates and make their own diagnoses, and as the diagnosis is as a rule quite straightforward this method answers very well. Occasionally, however, interesting cases outside the military line turn up, but it speaks volumes for the health of the troops to be able to state that pure medical radiography is extremely rare. Apart from diagnosing fractures, pieces of metal and their position, the most interesting work is in connection with wounds of the chest and their sequelæ, and wounds of the head and spine, with their concomitant sensory and motor symptoms. In these cases the co-operation of nerve specialist and radiographer in diagnosing the exact position of the missile is of great assistance to the surgeon, and at the beginning of the War I was lucky enough for a short time to be able to take part in the work performed by Dr. Gordon Holmes and Mr. Sargent at Paris. The diagnosis as to the exact position of the (say) bullet was made independently by the physician and radiographer, and the results were compared before and after operation.

Translation.

NOTES ON ACUTE MENINGITIS AMONG TROOPS IN THE FIELD.[1]

By Drs. SACQUÉPÉE, BURNET, and WEISSENBACH.

Bacteriological Laboratory of the IVth Army.

Our knowledge — clinical and bacteriological — on the subject of purulent meningitis is of comparatively recent date. The disease does not seem to have been investigated in the course of antecedent great wars. Its appearances among the troops of the 4th Army in the course of the present War give occasion for the following observations.

The number of cases that came to light from January to the end of June is equal to a ratio of 30 to 35 per 100,000 of the effective strength, a figure practically identical with that given by military medical statistics for the same period of the year in peace time. The occurrence rate of acute meningitis is thus shown to be the same in war-time as it was prior to the War. Notwithstanding this numerical similarity the cases of purulent meningitis[2] among the troops on service present certain special features.

First, as regards ætiology. The actual producing agents of the cases of meningitis investigated are, in point of fact, very varied. In a total of one hundred and twenty-one cerebrospinal fluids taken from cases of purulent meningitis we found the meningococcus present in sixty-two instances, i.e., approximately fifty per cent. In order to grasp the significance of these figures it must be borne in mind that before the War the meningococcus was quite commonly the *causa causans* in cases of purulent meningitis in military groups; if the proportion of such cases is put at between eighty and ninety per cent. the actual truth cannot be far departed from. Since the War cases of meningitis due to the presence of the meningococcus have shown themselves absolutely and relatively less frequently than before the War began.

Out of the remaining cases of purulent meningitis ten could not be studied in their entirety; while forty were due to the presence of various pathogenic organisms—parameningococcus, *Diplococcus crassus*, *D. flavus*, *Micrococcus catarrhalis*—others showed pseudo-meningococcus, streptococcus, pneumococcus, staphylococcus, tetragenes, enterococcus, pneumobacillus, *Bacillus paratyphosus* A. This list includes really all the pseudo-meningococci and all the pyogenetics.

Finally, six cerebrospinal fluids (a relatively higher proportion)

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[1] Translated from *Bulletin de l'Académie de Médecine*, No. 30, Séance du 27 Juillet, 1915.

[2] "Les méningites purulentes."

showed the features of the puriform aseptic meningitis of Widal, i.e., integrity of polynuclei, trifling increase of albumin; persistence of or increased power of reducing Fehling's solution; absence of organisms discoverable by means of direct examination or by cultivations. Correlatively, the six patients (from whom these cerebrospinal fluids were drawn) recovered with a rapidity which was quite remarkable.

As regards the actual producing agent of meningitis, the principal facts may be summarized as follows:—

For the whole group of cases investigated the number of those due to the presence of the meningococcus was only slightly in majority; cases of meningitis produced by other organisms are relatively numerous; aseptic puriform[1] reactions are by no means exceptional.

Having regard to the actual state of our knowledge of the method of transmission of cerebrospinal meningitis, there was reason to keep a look-out for "carriers" among those in contact with the patients suffering from cerebrospinal meningitis due to the meningococcus.

According to the tabular statement drawn up by one of us, in peace time, the average proportion of "carriers" among the "contacts" of the cases of this illness is from four to five per cent. Bacteriological examination, as far as possible under the same conditions, shows that the average proportion of "carriers" among troops on active service is about 1·33 per cent.

In view of the large number of examinations made by us these figures deserve some degree of consideration. They point to the fact that among the troops on active service the number of "carriers" is only one-third of the total number found among the troops previous to the War. Without labouring the point, it seems natural to establish a close connection between the diminished prevalence of meningococcal meningitis and the relative scarcity of "carriers" among those in contact with the patients. This scarcity of "carriers" is not surprising. The men are seldom so packed together that the word "overcrowding" can be used; the out-door life is a protection.

There has been no "epidemic" properly so called; but two groups of cases conveyed an impression of such prevalence. One of these prevalences necessitated our dealing with five successive attacks in the same regiment, in the space of six weeks; the two first attacks were meningococcal in origin; two others were due to the pneumococcus; the last was due to the streptococcus.

Notwithstanding the number and the close connection of the attacked, there was not, for that reason, any question of an epidemic, properly so called, of cerebrospinal meningitis, but merely of the linking together of several successive attacks of sporadic meningitis due to different species of micro-organisms.

[1] "Des réactions puriformes aseptiques."

It may be asked why the conditions brought about by the War have given rise to an unwonted number of cases of meningitis of various different types—some due to micro-organisms not usually showing a special affinity for the meninges; others exhibiting aseptic puriform[1] reactions which are probably due to the action of virus, or toxins, especially toxins of microbic origin, on the cerebrospinal membranes.

In our opinion, certain secondary causes must be playing a leading part in this connection, viz., fatigue, want of sleep, and especially the violent disturbance (*ebranlement*) produced in the cerebrospinal substance by the abrupt and sudden change of pressure caused by the bursting of explosives. These enormous changes of pressure may bring about grave symptoms constituting the aggregate of symptoms in caisson disease. Less violent, but constantly repeated, they cause a kind of hammering upon the central nervous tissue; a hammering which, in the end, must have the effect of rendering the nervous tissues specially vulnerable to the attacks of previously existing pathogenic organisms or to the action of the toxins elaborated by them. This explanation seems to us all the more reasonable because, in addition to the purulent lesions which, here, we have especially in view, we have also observed a large number (forty-two) of more elementary reactions characterized by an assemblage of the clinical features of meningitis, with or without meningeal cellular changes. Does not this mildness of symptoms undoubtedly indicate that the lesions are quite trifling, and not specifically infected?

In conclusion, it is impossible not to take into account the condition of "nerve strain," to use a current expression, to which the soldiers in the trenches are exposed during the hours, and, indeed, whole days, of bombardment; a condition so evident that competent observers have characterized it as a really pathological mental state which cannot possibly leave the nervous centres unaffected.

Current Literature.

Cholera.—Professor J. Kaup, of Munich, Consulting Hygienist with an Austrian Headquarters, reports (in No. 11 *Münch. med. Woch.*, p. 378, March 16, 1915) the results of protective cholera inoculations in the Austrian armies. First cases appeared on September 20, 1914, in a regiment belonging to an Eastern Galician army then in retreat. The regiment was promptly vaccinated; the vaccination was completed by the end of September. All other divisions of the same unit were inoculated, and, when completed, the attack-rate fell to one in ten, and then no cases were reported.

The vaccine consisted of an emulsion of vibrio in a 0·5 per cent. carbolic saline, killed at 53° C. First dose 1 c.c.; second dose, after six

[1] "Des réactions puriformes aseptiques."

to eight days, 2 c.c.; (1 c.c. appears to contain two loopfuls of an agar slant twenty-four hours' growth). No reaction followed the inoculations.

One of the above divisions, not vaccinated in time, was moved west to join another army, and as a consequence, cholera cases began to appear. The men were injected during incubation; after the first dose the disease took a very much milder course, and the mortality was much lower.

In another unvaccinated army corps, cholera was immediately stopped after first inoculation.

Still another *vaccinated* corps was operating in an infected area all through November, and a few cases only were notified. The ratio of men who had two doses, one dose and the non-vaccinated ones was 20 : 5 : 2.

The morbidity rate amongst the above groups was 24 : 62 : 80. Generally speaking, there were notified:—

1 to 2	cases	per 10,000	twice inoculated.
15	,,	,,	once inoculated.
50	,,	,,	non-vaccinated.

In the 3rd army many cases appeared in middle of October. On account of many difficulties, the vaccination was completed in the beginning of November only, and the disease was stopped. One of the army corps may serve as an illustration: Cases daily reported in October; vaccination completed by November 3. Since November 8 no more cases reported.

Out of 1,861 non-vaccinated, there died	...	545 = 29·3 per cent.
,, 299 twice vaccinated, there died	...	3 = 1 ,,

and 7 deaths amongst the once vaccinated (number not quoted).

As a result of the above successful vaccinations, all the "Ersatz" formations at home were compulsorily vaccinated twice.

4th Army: History as with 3rd army. General result: per 10,000 non-vaccinated—twenty cases; once vaccinated—three cases; fully vaccinated—one case only.

It must be emphasized that the extraordinary reduction of cases was not due to natural causes, viz., approaching winter. In winter one of the non-vaccinated formations was infected by carriers, and the disease began rapidly to spread. First case was notified on December 16. By January 16 the outbreak was arrested. No one on the vaccinated staff of the cholera hospital was taken ill. The mortality data for this outbreak were:—

778 non-vaccinated	...	...	303 = 39 per cent.
151 once vaccinated	...	...	39 = 26 ,,
40 twice vaccinated	...	...	6 = 15 ,,

The writer and the military authorities with him consider the vaccination to be the only possible and reliable protection of the troops on a terrain where big and rapid movements of troops take place constantly, and where it is impossible to ensure reasonable sanitary measures outside the military camps. Over 1,000,000 soldiers in all were vaccinated.

It has been noted, but no figures are given, that the percentage of cholera carriers is greater amongst the vaccinated soldiers.

The question of the duration of the protection is at present attracting a good deal of interest. The Balkan War experience has shown that six months is a minimum period of reliable immunity. Nine months are

tentatively advanced now as a minimum, but a re-vaccination of the troops is considered necessary.

Rosenthal and Werz, Military Hospitals, Nürnberg (*Münch med. Woch.*, p. 382, No. 11, March 16, 1915).—As the whole of the *German* armies were not vaccinated against cholera, isolated cases amongst the wounded brought home from the Polish battlefields were occasionally reported. Also numerous cases amongst the Russian prisoners in various camps. *It is interesting to record that many wounded are cholera carriers without any symptoms.* In December some 686 wounded were brought from Poland directly to the Nürnberg hospitals. One died of atypical cholera diagnosed on *post-mortem* only; thereupon all the rest were examined, and ten carriers were found. The twelfth case was a wounded man, brought in November, who developed an acute intestinal disease in December, and who was ultimately found to be infected with typhoid and cholera simultaneously. Amongst the twelve carriers nine showed no specific agglutination, two moderate agglutination.

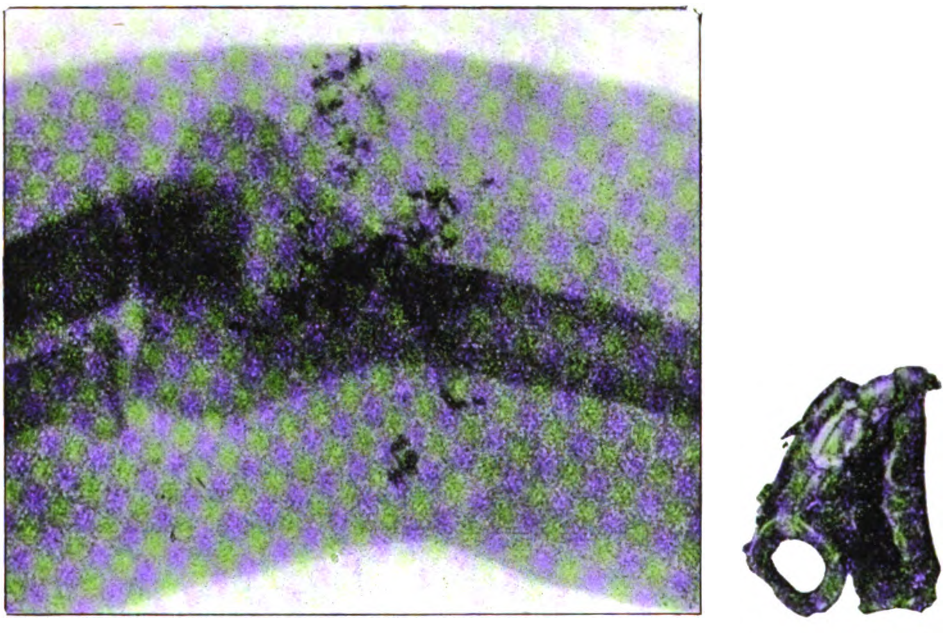
An analysis of some 250 of the above cases shows that the percentage of carriers is about three amongst the non-vaccinated and eight amongst the vaccinated.

It is recommended that finely powdered and officially tested animal charcoal be used for the treatment of cholera and dysentery. The charcoal acts as a powerful absorbing agent, and is said to give very successful results in apparently desperate cases. It must be tested both chemically and biologically, as there is a great variation in the absorbing properties of various samples (Wiechowski and others).

Typhoid. — (1) It is universally reported that blood cultures in *vaccinated* typhoid patients are, as a rule, negative. This is considered a great drawback, particularly as regards differential diagnosis between typhus and typhoid fever. As the agglutination test is also inapplicable in vaccinated patients, it is urged that the search for typhoid bacilli in fæces and urine is alone reliable as a bacteriological diagnosis. Max Neisser (*Munch. med. Woch.*, p. 142, No. 4, 1915) reported to a meeting of military surgeons of the V Army, on December 15, that under the circumstances the diazo test was more reliable than the blood culture (81 per cent. positive results as against 56 per cent. positive blood cultures in 700 typhoid patients examined during six weeks).

(2) Many attempts are being made, both in Austria-Hungary and Germany, to evolve a bacterial treatment of typhoid fever. Intravenous injections of typhoid vaccines, sensitized or not, are generally recommended. The dose is usually 0·5 to 1·2 c.c. of an ordinary vaccine containing 500 bacilli to 1 c.c. The reaction is very severe; critical fall of temperature, often far below the normal, sometimes collapse, &c. In straightforward, and generally in uncomplicated cases the effect of the injection is said to consist in a permanent reduction of the temperature, in an immediate general improvement, and in considerably shortening the course of the disease. In complicated cases, particularly when pneumonia and bronchitis supervene, the vaccine treatment fails, or gives, at the best, a temporary relief only.

R. Paltauf, of the Serum Institute in Vienna, whilst confirming the general belief in the efficacy of the treatment, warns against indiscriminate application, and limits its use to large hospitals only.



To illustrate "A Case of Dumdum Bullet Wound,"
by Stabsarzt d. L. Dr. F. SUDENDORF.

Neo-salvarsan (0·3 c.c., intravenously) is claimed by Professor Jacob to give results similar to those obtained with vaccine treatment.

Lastly, Lüdke recommends intravenous injections of deutero-albumose (1 c.c. of a 2 to 4 per cent. solution), since it is albumen and not specific antigen which, in his opinion, produces beneficial results.

A Case of Dumdum Bullet Wound.—Reported from the Reserve Hospital in Bautzen by Stabsarzt d. L. Dr. F. Sudendorf in the *Münch. med. Woch.*, February 9, 1915, p. 210. Reservist A. K., of the Infantry Regiment 103, Company 12, stated that the bullet wound of his right upper arm was received on September 20, 1914, before Laon, while storming the position of the English. When he was admitted to hospital on September 26 the following condition was found:—

Immediately above the right elbow-joint a wound of entry existed on the flexor aspect of the arm, on both sides of the tendon of the biceps. On the extensor aspect of the arm were two wounds of exit, one below and one above the right elbow-joint. None of the four openings was very large, the largest being those on the flexor and radial aspect. There was considerable discharge from the wounds above the elbow-joint, which, together with the lower third of the upper arm, was much swollen and inflamed, the overlying skin being reddened. The X-rays showed in the neighbourhood of the wound of entry, over the lower third of the upper arm, fragments of lead, scattered in profusion, of the size of small shot (calibre 0) and four or five times larger (buck-shot and larger).

A Dumdum wound of the right upper arm was diagnosed. In the course of treatment incisions were twice necessary. Through one, made on the extensor aspect of the joint, a great number of large and small fragments of lead were removed or came away of themselves. As, however, the joint threatened to become fixed, a general anæsthetic was given on October 26, a deep incision was made over the large wound of entry, and the outer covering (Mantel) of the Dumdum bullet was removed. The photograph shows plainly the opening at the point of the bullet, although it had been completely deformed. During the daily changes of dressing, small and minute fragments of lead were regularly discharged from the cavity of the wound (see illustration).

The Action of the Regular Infantry Bullet and of the Dumdum Bullet on the Human Body (Comments on M. Kirschener's publication by Professor G. Perthes, Generaloberarztes and Consulting Surgeon to the 13th Army Corps (K.W.), from the *Münch. med. Woch.*, February 9, 1915, p. 210).—Kirschener's communication to this journal for December 29, 1914, No. 52, contains conclusions with regard to the action of Dumdum bullets, which should not remain uncontradicted, on account of the interest shown in the demonstrability of Dumdum wounds.

It is difficult to agree with Kirschener when he says that the conclusion cannot safely be drawn from a very large and much torn wound, that a partially covered bullet (Teilmantelgeschoss) has been used, nor can I subscribe to the sentence in which Kirschener says of the action of the Dumdum bullet: "If a Dumdum bullet strikes only soft structures, it acts exactly like a regular infantry projectile. Its specific action comes into play only when it strikes a bone." The reverse of this proposition is the case.

As is well known, the explosive action of the "Teilmantelgeschoss depends on the obstruction opposed to the covering of the bullet when it strikes an object. The lead is carried through the opening in the point of the bullet, the outer covering of which is lacerated and is itself broken up into numerous small fragments, which cause extensive destruction in the surrounding tissues. Now it is of importance that not only bones but also the soft tissues cause sufficient obstruction to delay the passage of the outer casing, as compared with the core, and thus to separate the casing from the core, and to scatter the core broadcast. This fact, which is denied by Kirschener, has been proved to me by a small series of shooting experiments on horses which I made long before Kirschener's communication appeared. Previously I had repeated yearly the shooting experiments with Dumdum bullets by v. Bruns, my predecessor at the hospital in Tubingen, and have collected my own experiences in this question. The results of these shots at the bodies of horses, which had just been killed by a bullet in the head, were immediately investigated by exact anatomical investigations after every shot, and notes were made. Carbines were used, and the German infantry bullet, which was converted into a "Teilmantelgeschoss" by filing off its point. When I dismiss the shots which caused slight lesions of bone, there remain three shots through the upper part of the leg, involving only the soft structures. The distances at which these shots were fired were 20, 100 and 160 metres respectively. In each case there was a wound of entry corresponding to the size of the bullet. Beyond this there was a large lacerated cavity, occupying the whole length of the channel made by the bullet. This cavity could easily hold a fist in the case in which the range was only 20 metres. In the case in which it was 100 metres, the wound cavity was larger than a goose's egg, and in the case in which the range was 160 metres, the channel formed by the bullet easily transmitted two fingers. The wound of exit at the range of 20 metres was 8 by 5 cm. and irregularly torn. The wounds of exit at the ranges of 100 and 160 metres were slit-like and only a little bigger than the wounds of entry. In all three cases the wound cavity contained more or less numerous fragments of lead, varying in size from a pin's head to a lentil. In the wound inflicted at the range of 100 metres were some portions of the outer casing. The outer casing of the bullet fired at the range of 160 metres was found to have passed through the body of the horse, and though much torn, was almost complete and was free of its leaden core. A control shot [evidently with a German infantry bullet, not converted into a Dumdum—Translator] through the soft parts of the upper portion of the leg of a horse at a range of 20 metres showed on dissection a simple seton-like channel.

The experiments show clearly that not only the bones, but also the soft tissues afford sufficient resistance to provoke the explosive action of the "Teilmantelgeschoss," and to scatter the lead core in the smallest fragments. They show further, in complete unison with the results of six carefully examined experimental shots through bones, that the explosive action of the Dumdum bullet rapidly diminishes with the distance, and that at a distance of 160 metres, the irregular wound cavity forms a channel which is still large enough to admit two fingers.

Kirschener refers to his observations made on wild game in India, according to which the wounds of entry and exit were invariably small.

As our experiments on horses show, a small wound of exit in no way proves the absence of an explosive action. Behind the small opening in the skin there may be a large wound cavity. The small wound of exit is made by the passage of the outer casing (see shot at a range of 160 metres); the wound cavity made by the breaking up of the core does not often extend to the wound of exit in horses and big game which present large masses of soft tissue. On the other hand, the human tissues through which a bullet passes are so shallow that the large wound cavity extends to, and involves, the wound of exit, which must therefore be much bigger. It is impossible to take into consideration the experiments made on corpses, referred to by Kirschener, for there are no accurate data, notably no record of the range.

If, as Kirschener asserts, the Dumdum action were to occur only on contact with bone, there would hardly be any regular difference between the Dumdum and the usual infantry bullet, for this, too, at normal close range, at any rate on contact with the shaft of the bone, causes large lacerated wound cavities, owing to the bone being splintered. It is all-important that the explosive action of the Dumdum at short range occurs under every condition. At long range Dumdum bullets may cause no explosive effect. At least this is indicated definitely by the rapidity with which its explosive action diminishes as the range is increased.

A great importance to the question of the demonstrability of the Dumdum wound is the knowledge of the Dumdum action. Kirschener says: "The only sure proof that a wound is inflicted by a Dumdum is the discovery of the projectile in so slightly deformed a state that it is still absolutely demonstrable that the front end of the steel casing has been intentionally broken off before the cartridge was fired."

It is impossible for me to agree with this statement. On the contrary, if in a wound one finds a bullet with the shape of an undischarged Dumdum bullet, then it is proven that the bullet found has not had an explosive Dumdum action. Bullets which have had a Dumdum action can never be the subject of investigation as to the form they possessed before they were discharged, for the essential feature of the Dumdum action consists precisely in the mutilation of the casing and the scattering of the lead core into countless minute fragments of lead. Only when a Dumdum bullet inflicts a wound at a great range and does not, therefore, exercise its destructive action, is it conceivable that it may retain its shape. It may, however, be presumed that the men who shoot with Dumdum bullets know that their Dumdum action can be relied on only at close range, and that therefore they probably use Dumdum bullets only for fighting at short range.

The demonstration of a Dumdum wound is not to be made by the shape of an intact bullet found in it. Much rather is it to be demonstrated by Dumdum wounds inflicted at close range, in which numerous scattered fragments of lead are to be found in the tissues either by the Röntgen rays or—and this is less easy—by dissection.

This discovery of numerous small metallic particles in the wound is an absolutely conclusive proof of the use of Dumdums in fighting with the French. When in a bullet wound, which can only have been inflicted by the French infantry, small quantities of metal are detected, and when it is found that these particles consist of lead, then it is clear that the regular French bullet, which consists of copper and never breaks up into

small particles, has not been used. A "Mantelgeschoss" capable of breaking up must have been discharged

But even with regard to those of our enemies, such as the English and the Russians, who use the "Mantelgeschoss," this method of deciding whether a suspicious wound is really due to a Dumdum bullet is not to be undervalued, not only in the case of wounds of the soft parts alone, but also when bones have been hit. Certainly, after ricochetting, an ordinary "Mantelgeschoss," when striking hard bone, occasionally has its casing broken and its core broken up into fragments. Never, however, does a bullet conforming with the conventions break up into so small and so many particles of metal when meeting firm resistance after ricochetting as we see in Röntgen pictures of Dumdum shooting experiments, and as we see after dissection of Dumdum wound cavities experimentally caused. In these experiments the fragments were more numerous and small, according as the range was shortened. Also, when the regular bullet is reversed so that the case-free base is turned foremost, the same conditions do not exist as in the case of the Dumdum bullet. For when one discharges such a regular bullet with its base foremost, a Dumdum-like action may result at close range, but the conditions are not the same, as has been found by two experiments at a range of 20 metres. The regular S-bullet turns round ("ueberschlagt sich") only when its velocity is reduced by the resistance of the air or other substances. Then, however, the force required to break up the lead core into minute particles no longer exists. That the action of such a reversed regular infantry bullet is essentially different from that of a Dumdum bullet is demonstrated by shooting experiments which I (Professor Perthes) have made in Tubingen, and which I undertook in connection with Fessler's well-known investigations. When one places three pinewood boxes, each 50 cm. deep, together, the first filled with sawdust, and fires at a range of 100 metres, it is possible to follow the gradual rotation of the bullet as it advances sideways, and then turns round on its base. In no case was the separation of the casing from the core, and the breaking up into small metal particles, observed as a result of reversing the bullet; whereas, under similar conditions, the Dumdum bullet broke up into minute particles of lead, as was most beautifully demonstrated on the back wall of the first box, the front of this back wall being covered with cardboard.

We must therefore maintain that the discovery in a wound of particles of lead, of the size of a millet seed and smaller, which are found embedded around the wall of a large wound cavity, definitely indicates under all conditions the presence of a Dumdum wound. It is not denied that it is difficult to demonstrate the existence of a Dumdum wound when it has been inflicted at long range, and when the fragments of lead are few and large.

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Original Communications.

REPORT ON THE RESULTS OF THE BILHARZIA MISSION IN EGYPT, 1915.

By TEMPORARY LIEUTENANT-COLONEL ROBERT T. LEIPER, D.Sc., M.B.
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(*Continued from p.* 181.)

PART III.—DEVELOPMENT.

DEVELOPMENT IN INTERMEDIARY.

HETEROGONY. THE reproduction of digenetic trematodes takes the form known as heterogenesis or heterogony, of which the chief features are : (*a*) an alternation in the modes of reproduction, an asexual phase alternating with a sexual phase; (*b*) the asexual individuals differ in shape and in

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internal structure from the sexual forms; (*c*) the two kinds of reproducing individuals live under conditions which are more or less radically different. All digenetic trematodes have their asexual phase in the mollusca, and for the most part in the gastropoda. The sexual phase is attained in a vertebrate. The asexual phase has one or more generations. The egg on hatching gives rise to a ciliated larva, the "miracidium," which dies in about twenty-four hours unless it has been able to harbour in a suitable mollusc. Within this mollusc the miracidium, usually after migrating to the digestive gland or "liver," becomes changed into a smooth-walled sac called a sporocyst. Budding from the wall of the sporocyst results in bodies which may be of three kinds: (*a*) cercariæ; (*b*) daughter-sporocysts; (*c*) rediæ. The cercariæ are typically immature adults provided with certain larval structures to enable them the better to invade the definitive host. They are the infective forms.

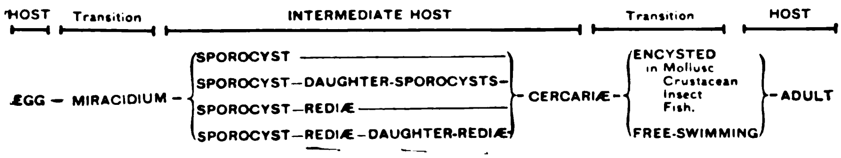

FIG. 40.—Life-cycle of a digenetic trematode.

The daughter-sporocysts are elongated sacs resembling the mother-cysts, and are not provided with alimentary canal or suckers. They migrate from the mother-cyst to other parts of the digestive gland, and later give rise by budding to cercariæ.

Rediæ are characterized by the presence of a single sucker and a simple sac-like alimentary canal. These give rise by internal budding (*a*) to cercariæ, or (*b*) to other rediæ which ultimately give a brood of cercariæ.

These four lines of development which may be taken by a degenetic trematode are graphically tabulated in fig. 40.

From the account already given of the experimental production of adult Bilharzia worms after submission of a suitable definitive host to infection by cercariæ, it was evident that bilharzia development probably followed one or other of these alternative courses. In fact, the Bilharzia worms are typical digenetic trematodes, and conform to the second type of development in the intermediary host.

The Bilharzia miracidium gives rise to a sporocyst, which in turn produces daughter-sporocysts (fig. 41).

After leaving the mother-cyst, the daughter-sporocysts migrate into the tissue of the digestive gland and grow rapidly. They become greatly elongated and eventually ramify throughout the organ, so increasing its bulk that an infected Planorbis can be

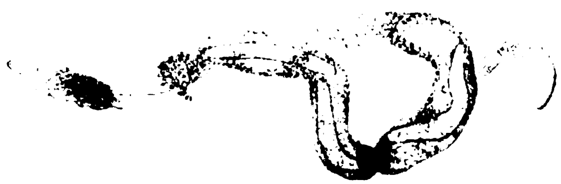

Fig. 41.—A sporocyst from Planorbis containing daughter-sporocysts. On the right is a free daughter-sporocyst.

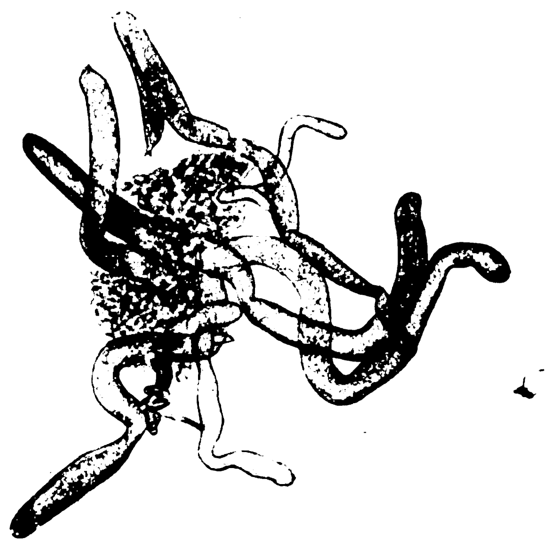

Fig. 42.—Daughter-sporocysts teased from Planorbis.

detected at a glance. The colour also of the organ is changed. In *Planorbis boissyi* the digestive gland is dark brown or black, but when infected this changes to ochre.

The ends of the daughter-sporocysts are solid, but the walls of the tubular bodies are very delicate and transparent, so delicate that it is impossible to dissect a complete sporocyst free from the tissues. As the cercariæ develop within them, the sporocysts may

become markedly constricted by the host tissue (fig. 44), and a certain amount of multiplication may possibly occur through cission. These sporocysts appear to absorb their nutriment through their walls, as they have neither oral sucker nor alimentary canal. The glandular tissue of an infected organ disappears apparently through pressure atrophy (fig. 44). The sporocysts are capable of travelling by wriggling movements. The cercariæ leave the sporocysts through

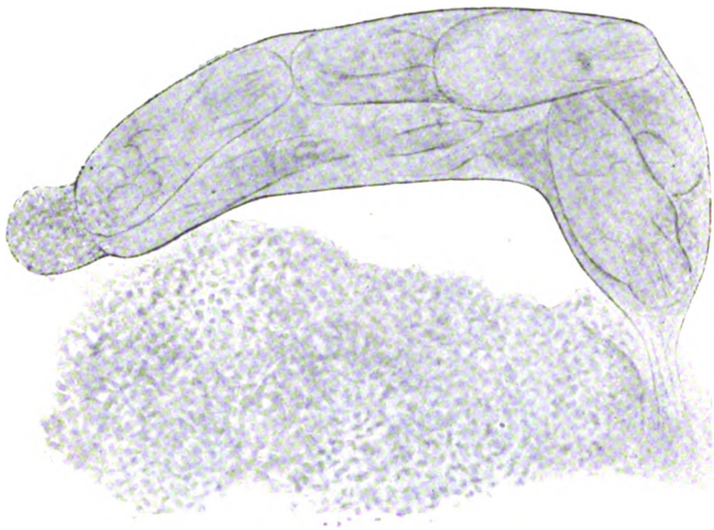

FIG. 43.—Terminal portion of a daughter-sporocyst containing fully developed cercariæ.

simple rupture of the over-distended wall. They are discharged from the mollusc in "puffs," a number being periodically shot into the water. This discharge occurs quite independently of the passage of fæces by the snail.

In Bilharzia as in all digenetic trematodes the terminal phase of development in the intermediate host is the cercaria, and this alone is the infective stage.

DIFFERENTIATION OF CERCARIÆ.

A cercaria consists typically of two parts, viz., body and tail. The tail is always discarded when the body enters its final or definitive host. It is therefore a purely larval structure. The body, on the other hand, is actually the undeveloped adult, many of

the adult characters being almost undifferentiated. In addition to these the cercarial body may have other structures which have been serviceable during its growth in the molluscan host, but which are absorbed and entirely disappear after the final host has been reached. There are, then, in every cercaria "adult" characters and "larval" characters, the former being chiefly exhibited by the digestive, excretory and genital systems and by the oral and ventral

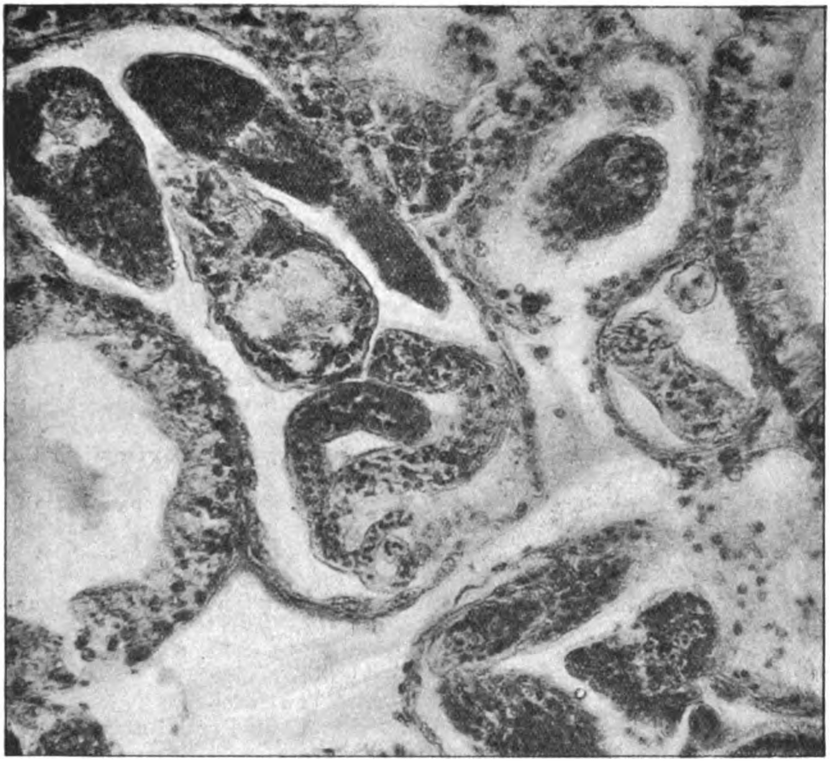

FIG. 44.—Section of digestive gland of infected *Planorbis boissyi*, showing extent of atrophy of tissue.

suckers, the latter by the tail and by the armature of the skin, the mouth, and body. By utilizing the "adult" characters, especially those exhibited by the oral and ventral suckers, the cercariæ may be placed in one or other of the four great groups into which the adult digenetic trematodes are subdivided, namely, Gasterostomidæ, Monostomidæ, Amphistomidæ and Distomidæ. (With the exception

of a small group in which the body shows practically no internal differentiation and to which the special name "lophocerca" has been given.) For the purposes of differential diagnosis the cercariæ, being all at the same stage in development, may be regarded tentatively as a separate group of animals, and their differentiation based upon their most striking characters, whether they be "adult" or "larval." The classification of the cercariæ proposed by Lühe in 1909 resolves the distome cercariæ into easily recognizable subdivisions with a corresponding descriptive terminology derived partly from the generic nomenclature proposed by Diesing in 1858. These subdivisions are based upon the character of the tail.

LÜHE'S CLASSIFICATION.

A. GASTEROSTOME cercariæ.	Mouth opening in the middle of the ventral surface. Intestine simple sac-shaped. Two long projections from the end of the body.
B. MONOSTOME cercariæ.	Ventral sucker lacking.
C. AMPHISTOME cercariæ.	Ventral sucker at the posterior end of the body.
D. LOPHOCERCARIÆ.	Cercariæ with longitudinal cuticular projections along the sides of the body.
E. DISTOME cercariæ.	Ventral sucker towards middle of body.
(1) Cystocercous cercariæ	Base of the tail forms a space into which the body can be drawn.
(2) Rhopalocercous cercariæ.	Tail having as great or greater width than the body.
(3) Leptocercous cercariæ.	Tail straight, slender, and narrower than the body.
(a) Gymnocephalous cercariæ.	Anterior end rounded, without stylet or boring spine.
(b) Echinostome cercariæ.	Anterior end with a collar and crown of thorns.
(c) Xiphidiocercariæ.	Anterior end with stylet.
(4) Trichocercous cercariæ.	Tail set with spines.
(5) Cercariæ.	Tail entirely undeveloped.
(6) Rattenkönigcercariæ.	Cercariæ with tails joined, forming a sort of colony.
(7) Microcercous cercariæ.	Tail stumpy.
(8) Furcocercous cercariæ.	Tail forked at its end.

DESCRIPTION OF BILHARZIA CERCARIA.

The various trematode larvæ found in each genus of fresh-water molluscs in Egypt are tabulated according to this classification and are described in a succeeding part. Their chief interest in relation to the present inquiry lies in their similarity to the Bilharzia cercaria.

When bilharzial cercariæ are seen floating in water the most

noticeable character is the presence of a Y-shaped tail. This character is common to the group lophocerca and to the furcocercous division of the distomes. In the former group the ventral sucker is absent, in the latter it is well developed. It is to this

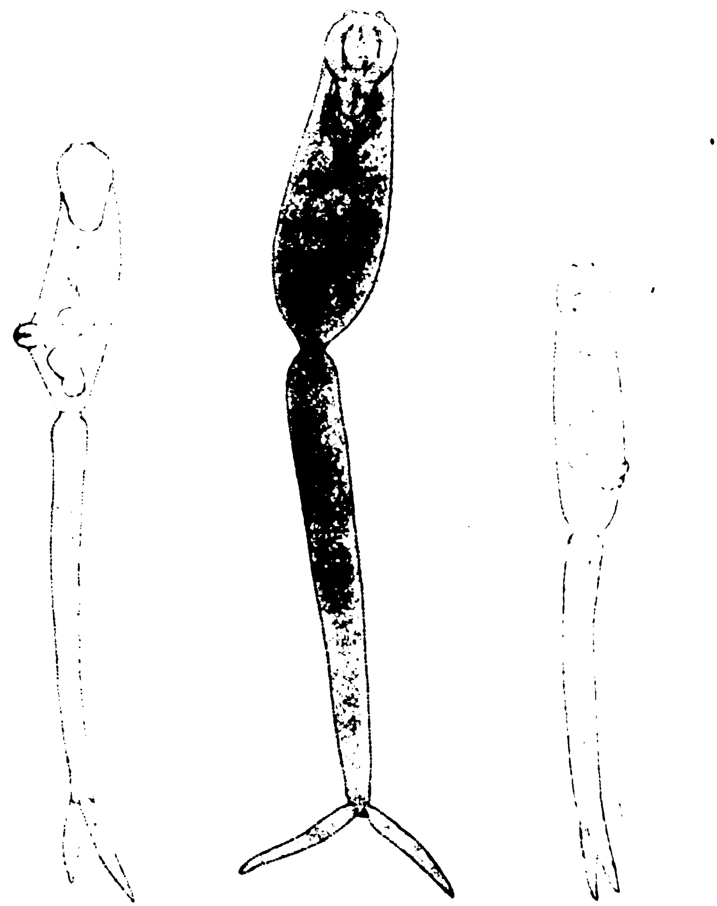

Fig. 45. Fig. 46. Fig. 47.

Figs. 45, 46, 47.—Various Bilharzia cercariæ found in molluscs around Cairo.

latter group that the Bilharzia cercariæ belong. The following furcocercous cercariæ were found: *C. vivax* in Cleopatra; C. *fissicauda* in Bullinus; a form very similar to *C. ocellata* in Melania, *Planorbis boissyi* and *P. mareoticus*, which we provisionally named "*C. bilharziella*"; and the cercariæ of bilharzia in Bullinus and in

P. boissyi. *C. vivax* and *C. fissicauda* both possess a muscular pharynx behind the oral sucker, in the other forms this is absent. "*C. bilharzia*" and "*C. bilharziella*" are related and probably belong to closely allied genera in the family Bilharzidæ. "*C. bilharziella*" possesses a pair of pigment spots anterior to the ventral sucker and there is a cuticular keel along each side of the prongs of the tail. These are absent in the Bilharzia cercariæ.

The relation or identity of the Bilharzia cercariæ found in the molluscs Bullinus and Planorbis will be discussed in the articles dealing with the adult worms.

Skin Infection.

Experimental evidence has already been given (p. 44) in favour of the direct penetration of the skin and of the mucous membrane of the mouth and gullet by the Bilharzia cercaria. Many writers appear to have the greatest reluctance in accepting the possibility of skin penetration. Some, like Allan, believe that infection is limited to the tender skin of the prepuce and advocate universal circumcision; Ruffer and others interpret infection during immersion in Bilharzia-infested countries as due to entrance of the cercaria through the anus.

In the *United States Naval Medical Bulletin* for October, 1915 (p. 648), Post writes that our experimental infection of rats by immersion "clearly shows, it seems to me, that the most usual port of entry must be the anus."

It may be pointed out, however, that: (*a*) Certain cercariæ are known to penetrate the tissues of the second intermediary host to encyst, and are provided with special glands and, in some cases, stylets to enable them to do this. (*b*) If a young rat or mouse be suspended in a large test-tube containing water full of Bilharzia cercariæ, these cercariæ can be seen to approach and fasten on to the limbs and body of the animal. When the animal is removed half an hour later, there remain in the fluid only a few cercariæ and a large number of *detached* tails. (*c*) A young mouse so immersed for half an hour was killed, and subsequently embedded whole in paraffin. Sections of the body and of the limbs showed the cercariæ at all stages of entry. They were found in the act of passing through the unbroken skin, and not through the pores or hair-follicles (*vide* figs 49 to 55).

The cercariæ seemed to be attracted by the warmth of the body, as similar evidence was rare in a recently dead mouse similarly immersed and the degree of penetration slight.

FIG. 48.

FIG. 49.

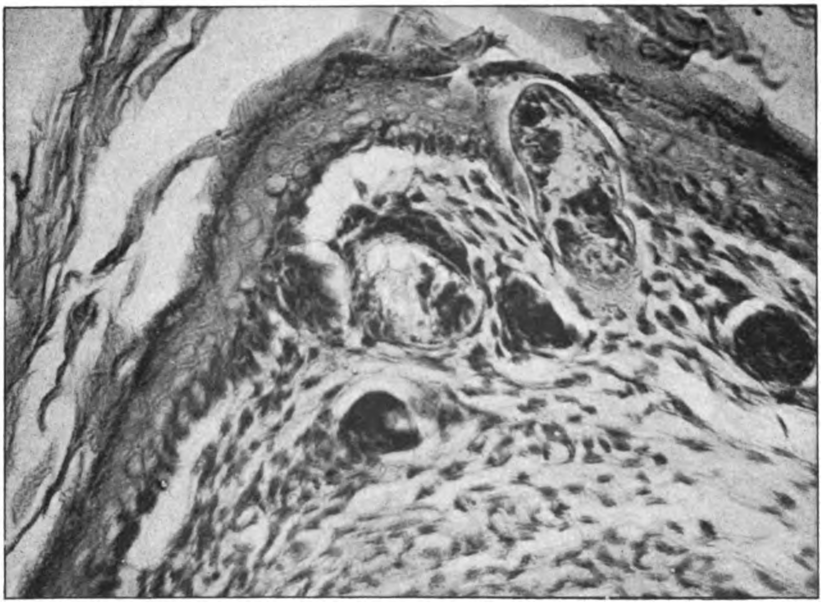

FIG. 50.

Figs. 48, 49, 50.—Micrograms of sections of skin of a newly born mouse which had been immersed for half an hour in water containing large numbers of Bilharzia cercariæ.

To illustrate "Report on the Results of the Bilharzia Mission in Egypt, 1915," by Temporary Lieutenant-Colonel ROBERT T. LEIPER, D.Sc., M.B., R.A.M.C.

FIG. 51

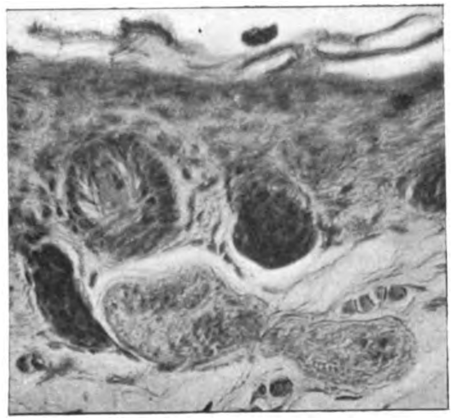

FIG. 52.

FIG. 53.

FIG. 54.

Figs. 51-54.—Sections of skin of a newly born mouse which had been immersed for half an hour in water containing large numbers of Bilharzia cercariæ.

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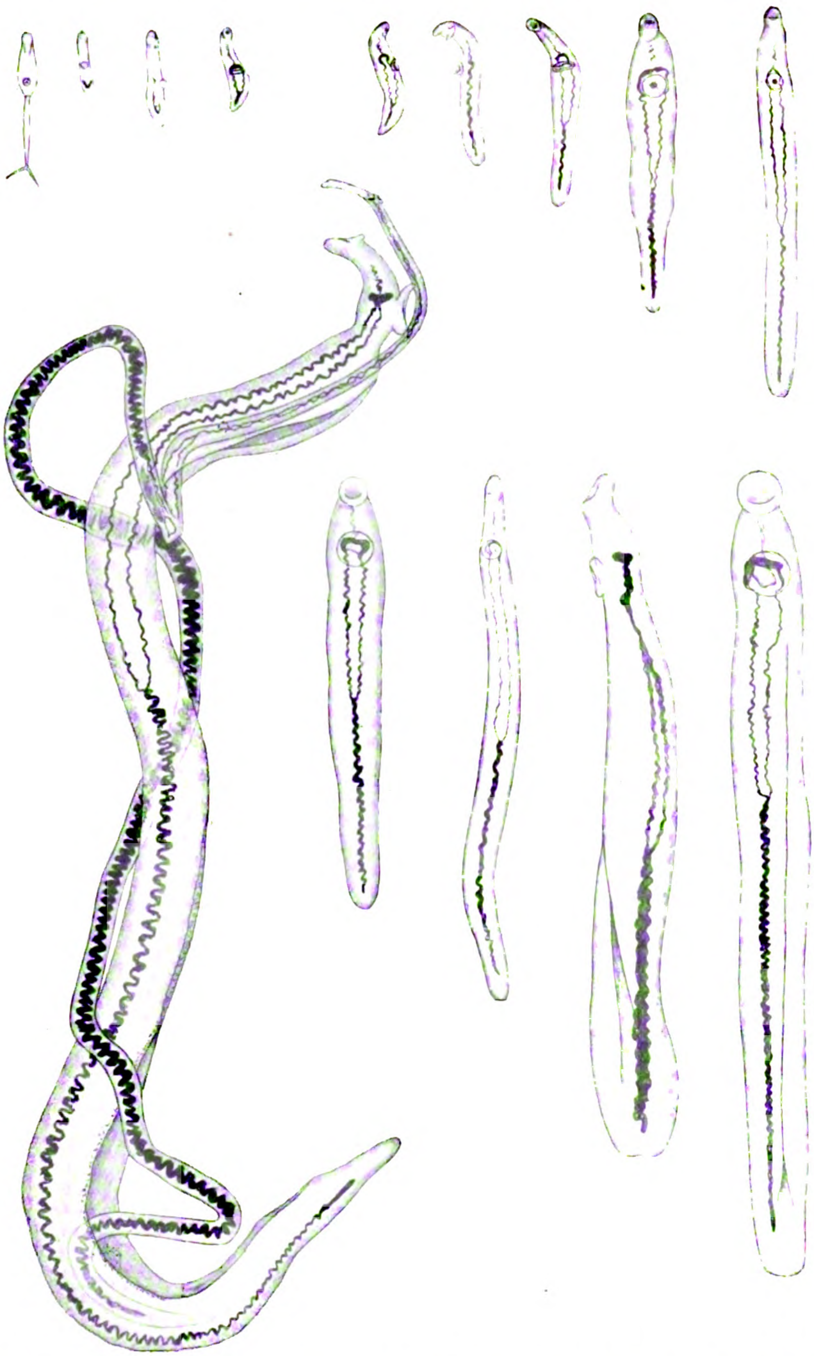

FIG. 55.—Bilharzia worms at various stages of development obtained from the liver of a rat and of a guinea-pig experimentally infected two months previously.

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Development in the Definitive Host.

Once the cercaria has entered the definitive host it undergoes no further metamorphosis. There is gradual growth with differentiation of organs, and in Bilharzia with differentiation also of male and female individuals. The males are early recognizable from the females by their greater breadth and the stouter formation of the ventral sucker. In the accompanying plate is figured, under the same magnification, at the various stages, the gradual development of the adult body in all its phases from the cercaria before it enters to the paired egg-producing adults two months later. The route taken by the cercarial body in its transit from the skin to the portal system is still under investigation. It is noteworthy here, however, that the cercariæ do not all appear to arrive in the liver at the same time. Some of the smallest forms were obtained by teasing liver which contained also forms almost fully grown. This accords with Professor Looss's experience in ankylostome infection. A number of larvæ probably become "lost" in the tissues. It may be, however, that a certain number enter the blood-stream direct, while others pass first through the lymphatic system.

(*To be continued.*)

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(*Continued from p.* 192.)

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(*Conclusion of Bibliography.*)

BERIBERI IN LEBONG.

An Account of the Steps taken to Eradicate the Disease during 1914.

By Major J. C. KENNEDY.
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In the year 1911 an epidemic broke out amongst the men of the 3rd Middlesex Regiment stationed at Lebong which presented the symptoms of multiple peripheral neuritis. The disease continued to make its appearance in 1912 and 1913, occasioning much concern, and was the subject of investigation by the sanitary officer of the Division and of reports from the medical officers of the station.

These officers all agreed in being unable to assign any definite cause for the disease, and were able to eliminate such causal agents as alcohol or arsenic.

No record of a similar disease having occurred at Lebong prior to 1911 could be found, and the fact that the regiment affected in that year had come from Singapore in the previous cold weather gave rise to the theory that the disease had been imported and was of an infectious or contagious nature.

In November, 1912, The King's Own Regiment relieved the Middlesex at Lebong. In June, 1913, the disease broke out again, and by the end of November sixty-five cases had occurred.

In consequence, the D.M.S., India, appointed a Committee to investigate the nature and cause of the disease and to report by what means it could be prevented. This Committee, consisting of Major E. D. W. Grieg, I.M.S. (President), Major F. Harvey, R.A.M.C., Captain G. I. Davys, I.M.S., and myself, met towards the end of December, 1913. We were handicapped in our investigations by the fact that the regiment had left Lebong for the Dacca manœuvres, leaving behind only a detachment which consisted chiefly of convalescents and men attending hospital for slight symptoms of the disease. Futhermore, none of the cases in hospital were of recent origin, thus precluding any satisfactory bacteriological or clinical research work. There seemed to be no doubt, however, that the disease was beriberi.

In view, therefore, of the large and ever-accumulating amount of recent research work which points to this disease being due to a deficiency in an element of diet, vitamine, which is essential

for the proper nourishment of nerve tissue, we directed our attention mainly to the investigation of the dietary of the regiment. At the same time we endeavoured to keep before us the rival theory of those who believe that the disease is a specific infection.

It is not within the scope of this paper to relate the details of our investigations; suffice it to say that in a very short time even those of us who were the most sceptical of the vitamine theory had begun to look upon the food of the troops with the gravest suspicion.

Put very briefly, the conclusions of the Committee were :—

(1) That the disease was beriberi;

(2) That as regards the available clinical material there was no evidence of a bacterial or protozoal causal agent;

(3) That the food of the troops could only be described as dangerously lacking in vitamine content;

and they recommended—

(1) That a fixed dietary be laid down;

(2) That the cooking be specially supervised;

(3) That an officer be appointed for a year to supervise the whole rationing of the troops, including quality of food, preparation, cooking, serving and all details;

(4) That the troops be regularly weighed and records kept.

The immediate result was that I was ordered to proceed to Lebong at the end of February to do what was possible to carry out the recommendations of the Committee. My duties began on March 1 and finished at the end of October on the departure of the regiment for England.

My official report was submitted in due course, and this paper is the result of a request for its publication. The report is a lengthy one, and I have been requested to present it in an abridged form suitable for publication.

The points that engaged my attention during the year were many, and it is necessary, in order to give a lucid account, to place my observations and record my facts under separate headings.

Table No. I gives the monthly incidence during 1914 compared with previous years and does not include readmissions or relapses.

During 1913, 65 men of the King's Own contracted the disease at Lebong, and 9 at Barrackpore, making a total of 74. Of this number 38 continued to require treatment during the early part of 1914 or relapsed during the year. All these men, with the exception of one who died, were fit when the regiment left Lebong on October 26.

The Incidence of Beriberi in 1914.

Table I.

	1911	1912	1913	1914
January	—	—	—	—
February	—	2	—	—
March	—	2	—	—
April	—	—	—	—
May	—	1	—	—
June	—	—	2	1
July	2	2	5	1
August	5	7	15	1
September	3	3	25	1
October	21	7	12	—
November	15	2	6	—
December	—	—	—	—
	46	26	65	4

Of the 4 cases contracted in 1914, 1 died, 2 were able to proceed home with the regiment, and the fourth was able to join the regiment before it sailed from Bombay. This is a very great contrast to the state of health obtaining in the regiment at the end of 1913.

Table II.

Incidence by Companies		A	B	C	D	E	F	G	H		
1913	..	1	3	12	12	10	18	2	7	=	65
1914	..	3	—	—	—	—	—	1	—	=	4

Table III.

Incidence by Bungalow No.	1	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1913 ..	—	2	1	—	—	—	2	1	2	2	5	9	—	5	7	6	12	6	4
							and 1 in hospital												
1914 ..	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	1

Referring to Tables II and III, I would draw attention to the point that 3 of the 4 cases in 1914 came from "A" Company, occupying bungalows 18 and 21. These bungalows, along with 19 and 20, are situated at the lowest and remotest part of the cantonment (*vide* plan) and in 1913 provided 28 out of 65 cases and, with bungalows 16 and 17, which are just as badly situated, 40 cases. Later, I venture to suggest an explanation of this fact.

It is of importance to study the history of each case, and I give the particulars in full.

Case 1.—Private P., aged 24, one year and three-quarters in India, "G" Company, admitted June 22 from dormitory 2, bungalow 5, which he had occupied for the last six months. In 1913 there was 1 case in the same bungalow but none in his dormitory. There were 9 "contacts" (men occupying the same dormitory). None of

these "contacts" had had beriberi and none showed signs of the disease, but 5 of them had lost five pounds weight or more up to June 13. During the period April 25 to June 13 it had been noted that 13 men of "G" Company had lost five pounds or more in weight and 6 of them (including Private P.) lived in this dormitory. It was found that 3 had suffered or were still suffering from gastric trouble and diarrhœa, the other 2 seemed quite fit but complained of their food—that they could not eat the meat and did not get enough variety. These "contacts" were kept under observation and remained fit, though 1 required treatment for indigestion and loss of appetite.

Personal Particulars. — Not a beer-drinker, a very moderate smoker, not an athlete, but was not in the habit of sleeping in the afternoons; lost five pounds weight in a month.

Previous History.—In hospital from March 16 to April 20 with sprained ankle and eczema. Ever since his discharge from hospital he had not felt fit and lost his appetite. In the beginning of June he had diarrhœa for about ten days, and while on company training got very wet three days in succession. From this time he began to suffer from pains in his legs and felt breathless. On June 10 he began physical training and after a day or two his legs got swollen, painful and weak, and on the day of his admission to hospital he could barely walk.

Progress of Case.—This was a mild case and did not develop acute symptoms. He had loss of knee-jerks, weakness of leg muscles but no actual paralysis, patches of anæsthesia, and, later on, some cardiac dilatation.

Case 2.—Private B., aged 24, two and three-quarter years in India, "A" Company, admitted July 21 from dormitory 4, bungalow 18, which he had occupied for the last six months. In 1913 there were 6 cases in the same bungalow and 3 in the same dormitory. There were 15 "contacts." One had had beriberi in 1913 but was a mild case and had been doing full duty since March 16. Two had been admitted to hospital some weeks previously with swollen legs, due in one case to valvular disease of the heart, and in the other to severe eczema with debility and disordered action of the heart.

Personal Particulars.—Not a beer-drinker, a moderate smoker, athletic; lost five pounds weight.

Previous History.—He suffered from malaria at Barrackpore in 1913. His first symptoms appeared on July 5, when he reported sick with diarrhœa and vomiting and attended hospital for treatment till July 20, when he was admitted to hospital. Under

treatment the vomiting stopped at once and the diarrhœa in a few days, but he continued to be debilitated, and when allowed up developed disordered action of the heart. About August 10 he complained of pains and stiffness in his legs, and the knee-jerks were found to be absent.

Progress of Case.—Acute symptoms of the disease very rapidly appeared in spite of all treatment and culminated in acute dilatation of the heart. He died on September 19.

Case 3.—Private D., aged 22, three years in India, "A" Company, admitted September 5 from dormitory 3, bungalow 21, which he had occupied for the last six months. In 1913 there were four cases in the same bungalow and one in the same dormitory.

There were ten "contacts." None of them had had beriberi and all were fit.

Personal Particulars.—Not a beer-drinker, a non-smoker, not athletic, but not indolent in habits; lost eighteen pounds in weight.

Previous History.—In hospital for malaria, April 21 to May 4, and June 20 to June 30. After discharge from hospital he attended for quinine and then joined his company at physical training during the latter three weeks of July. He states that he found the course rather a strain and had to fall out on occasions. On July 29 he began company training, and after doing about two weeks of this he got diarrhœa and began to feel seedy. He got worse, feeling faint and giddy and vomiting at times, and reported sick. He attended hospital, but as he did not improve was admitted on September 5.

Progress of Case.—The vomiting was very persistent about the time of his admission and was not controlled for some days. Slight symptoms of the disease developed, affecting the legs chiefly and to a lesser degree the heart. He made a good recovery.

Case 4.—Private A., aged 26, three and a half years in India, "A" Company, admitted September 27 from dormitory 2, bungalow 18, in which he had lived for the last six months. One case occurred in this dormitory in 1913.

There were eight "contacts." None had beriberi and all were fit.

Personal Particulars.—Not a beer-drinker, a moderate smoker, not an athlete and occasionally indolent, well developed physically, and had lost sixteen pounds weight.

Previous History.—Had pneumonia at Dacca in December, 1913. About the end of August, while on company training he began to feel ill. He lost his appetite, sometimes vomited, suffered from cough at night, and complained of tightness in his chest. He

reported sick and was admitted to hospital and diagnosed bronchial catarrh. After his discharge on September 16 he felt all right for two or three days, but as soon as he attempted full duty his legs began to get painful and swollen. On his admission to hospital on September 27 his legs were œdematous and there were patches of anæsthesia, and the knee-jerks were absent.

Progress of Case.—The case did not develop further, and made a rapid recovery.

The Dietary.

In view of the findings of the Beriberi Committee, my duty was obviously to see what could be done by thorough supervision of the dietary of the regiment.

The British soldier in India receives from Government a ration consisting of meat, bread and potatoes one pound of each, rice and flour two ounces of each, and some sugar and tea. As a rule only three-quarters of a pound of potatoes is drawn from the commissariat and for the other quarter a quantity of mixed vegetables of the same value, and consequently varying in amount according to the market prices. This item is of importance and should always receive careful attention. He also receives a messing allowance of two and a quarter annas a day, and in addition it may be reckoned that he gets a grant of at least one pice a day from the president of the regimental institutes.

The messing is run generally on the company system and can be done well and economically in the Plains.

In the hills, however, and particularly at Lebong, the messing cannot be run either so economically or so efficiently, because the rations are not as a rule so good, and the extras which are required to supplement the rations are more difficult to obtain and much more expensive.

For instance, the meat ration at Lebong is distinctly poor. The cattle (which the Indian does not breed for food) have to be driven some hundred miles from the Plains to the foot of the Hills and then a further forty miles into the Hills. When slaughtered they are, as a rule, in miserable condition, although they are allowed a rest of a fortnight at the foot of the Hills and are not supposed to be killed for some days after arriving at Darjeeling. They are not grain-fed and the pasturage is poor. The meat is deficient in fat, tough, and has an excess of bone. There is no doubt that the vitamine value of such meat must be low.

Again, such supplementary articles of food as fresh milk and

eggs, important for their vitamine value, were almost entirely lacking in the men's dietary. Fresh milk, on account of the difficulty of obtaining it in sufficient quantity and its expense, was replaced by tinned milk, an article of no vitamine value. Eggs were bad, unless a price was paid that was prohibitive for the men.

Furthermore, an examination of the messing books revealed the fact that the men's taste did not lie in the direction of such articles as oatmeal, peas, lentils, or barley—all valuable supplementary foods, especially where the meat ration is of poor quality.

Lastly, there was an undoubted tendency to monotony in the diet. This fact and the poor quality of the meat had a depressing effect on the appetite.

During 1914 there was a distinct improvement in the quality of the rations supplied to the troops, but the raising of the standard of the messing to that desired by the Beriberi Committee was a matter of considerable difficulty.

It was obvious from the first that it would be quite impossible to raise the standard of the messing without increasing the expenditure. The messing money was quite inadequate. With the aid of the master cook I drew out a specimen diet on the lines of that laid down by the Beriberi Committee, economizing where possible, and making alterations to suit the taste of the men. It was found that such a diet would cost at least four annas per man per day. The commanding officer went into the matter very carefully, and, at a meeting representative of the regiment, it was decided to raise the messing contribution for each man to four annas per day. This, along with a grant from the president of the regimental institutes, brought the sum available for messing to four and a quarter annas per man per day. By means of lectures, commanding officer's orders, and personal supervision, the company messing committees were instructed how to draw up their weekly diet sheets, which had to be approved by the commanding officer. At the end of each week the actual daily menu of each company was submitted to me, and I drew the attention of the commanding officer to any deficiencies or suggested further improvements.

The attention of the messing committees was directed to the following points: Fresh milk to be used instead of tinned. A different dinner to be given each day. Full use to be made of bones for stock, and soups to be given as often as possible. Sweet puddings three or four times a week. Full use to be made of the

flour ration in making dumplings and pies. (A large proportion of the rice and flour ration used to be sold.) As much use as possible to be made of the following articles: eggs, moong dhal, oatmeal. Extras to be provided for tea; advantage to be taken of the heart, liver, tails, brains, &c., of ration animals. The tea hour was changed from 4.30 to 6 o'clock, and a substantial meal provided. Formerly nothing was provided beyond tea and dry bread between midday dinner one day and breakfast the next day. "Chota hazri" was also insisted on before early morning parade.

The cooking was very carefully supervised, and every endeavour was made to make the meals appetising. Owing to the inferiority of the rations, it was found that a very large proportion of the meat was thrown away unless it was served up in some form of mince.

The new dietary was, on the whole, appreciated by the men, but, of course, there was grumbling at the extra expense. Under the old system many men, probably the majority, bought suppers for themselves at night, but the new scheme relieved them of this, and at the same time assured that *every* man had a substantial meal in the evening. In this connection an important point should be noted, viz., the peculiar conformation of the cantonment and the relation of the various bungalows to the coffee-shop. The lowest bungalows (*vide* plan) are a considerable distance from the coffee-shop, and not many men would take the trouble to climb three hundred feet to buy their suppers, especially if at the same time they ran the risk of being soaked to the skin. This difficulty had been recognized by the regimental authorities, and the men had been permitted to cook their suppers in their own rooms. The objections to such a practice will be evident.

In September the Government of India sanctioned the issue to the British troops in Lebong of the extra articles of diet recommended by the Beriberi Committee and ordered the scales and issues to be fixed by the local medical authorities. Thereupon a requisition was made for the supply of the following articles:—

Moong dhal to be issued four times a week; dripping or suet, daily; cocoa, twice a week; jam, twice a week; oatmeal, twice a week; split peas, once a week; barley, once a week; blue peas, once a week; mutton, twice instead of once a week; whole-meal bread, twice a week as an experiment; vegetables, a fixed ration of 7 oz. in addition to 12 oz. of potatoes; meat, 20 oz. ration (as ration meat contains about 30 per cent bone).

This order came too late to benefit The King's Own Regiment, but it is hoped that the arrangements will be completed for the troops this year.

I should at this point like to say how much I appreciated the hearty co-operation of the regiment, from the colonel downwards, in carrying out the work, which entailed on them no little pecuniary sacrifice.

Appended are two actual weeks' diet sheets as samples of the messing during 1913 and 1914 respectively :—

"E" COMPANY, FROM JULY 1 TO JULY 7, 1913.

Breakfast	Cheese & onion	Meat & salad	Bacon & tomatoes	Steak & onions	Bacon & onions	Butter	Cheese & onions
Soup ..	..	..	..	..	..	..	..
Meat ..	Roast	Stew	Roast	Roast	Stew	Roast	Stew
Pudding ..	..	..	..	..	..	Stewed peaches	..
Tea ..	Tea and bread ; no extras.						

"A" COMPANY, FROM AUGUST 2 TO AUGUST 8, 1914.

Breakfast	Cold pork & sauce	Porridge & butter	Steak & onions	Bacon & onions	Eggs & butter	Porridge & cutlet	Butter
Soup ..	..	Dhal	..	Dhal	..	Barley	..
Meat ..	Roast	Hotpot	Brown stew	Roast	Irish stew	Potato pie	Irish stew
Pudding ..	Currant	..	Rice	..	Treacle	..	..
Tea	Potato cutlets	Eggs & butter	Sausage tomato	Cold meat & salad	Potato pie	Butter	Meat rissoles.

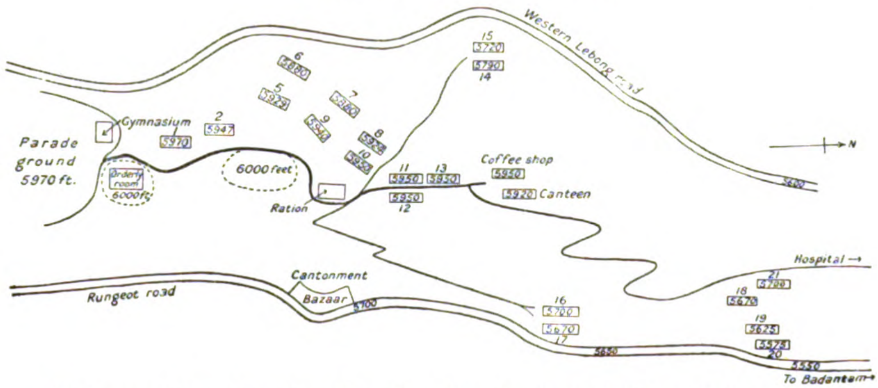
ACCOMMODATION AND HYGIENIC CONDITIONS.

The accompanying plan of the Lebong Cantonment shows the disposition of the bungalows and their heights above sea-level. Bungalows 11, 12 and 13 are situated on the ridge of the spur of Lebong, the others lie on the slope on either side. Owing to the steepness of the mountain side these latter have been built parallel instead of at right angles to the side of the mountain, consequently they are all more or less overhung. This fact interferes with efficient ventilation and in the rainy season renders them very damp. The bungalows on the western slope suffer most from this disability and are also more exposed to the prevailing damp winds. The dampness of these bungalows was clearly demonstrated when

I took up the flooring of one of the rooms (4 Bungalow 20). The majority of the men in this room were suffering from some ailment such as sore throat or diarrhœa and complained of a smell. The earth underneath the flooring was damp and mouldy, and the musty odour was simply overpowering. The investigation resulted in my contracting a severe sore throat.

To put it mildly, there is no doubt that such a condition must have a depressing effect on the health of the men, and it has been strongly recommended that the bungalows should have a concrete basement and thorough ventilation between the basement and the flooring. It is interesting to note that two of the bungalows (Nos. 6 and 7) already have concrete basements and that no case of beri-beri occurred in either of them in 1913.

Rough plan of Lebong Cantonment, showing the altitude of each bungalow, thus $\boxed{5950}$, in feet above sea-level.



Distances: From Bungalow 20 to the coffee-shop is about 730 yards by a steep winding path. From the coffee-shop to the Parade Ground is 660 yards.

I have already referred to the fact that the six bungalows Nos. 16 to 21 with a nominal accommodation of 338 out of a total of 890 provided 30 out of 60 cases in 1913, and 3 out of 4 in 1914. I am inclined to believe that a partial explanation may be found in the great distance between these bungalows and the parade ground and the difference in altitude. A man living in No. 20 has to go three-quarters of a mile (reckoned on the level) and climb a height of 425 feet. He probably does this before breakfast, and at least once between breakfast and dinner. Then again, the canteen and coffee-shop are 730 yards distant and 375 feet higher up. I feel sure that these facts should be borne in mind

when regulating the training of the men, especially when we consider the altitude and the effect of the climate on the general health.

The accommodation was found to be deficient. By reason of the bungalows being only 20 feet broad instead of 22 feet, each man had 6 square feet of floor space or 60 cubic feet less than the regulation. As soon as this was appreciated the number of men in each room was readjusted and it was found necessary to send about 100 surplus men to Barrackpore.

Throughout the year two rooms were set apart for the segregation of those men still attending hospital for beriberi contracted in 1913, and four rooms were kept vacant for the reception of "contacts" of fresh cases. As soon as a fresh case occurred the room was vacated and disinfected and the "contacts" were sent to a vacant room and kept under observation.

Loss of Weight.

As I have already pointed out, all the 1914 cases of beriberi suffered considerable loss of weight. Loss of weight is an important prodromal of beriberi, therefore the regular weighing of the troops should be of great assistance in the early detection of the disease.

In spite of the improvement in the dietary of the regiment there was a general loss of weight during the year, and for this I have endeavoured to find some reason. To this end the weighings were taken as far as possible at the beginning and end of the different courses of training.

The accompanying chart shows the average loss or gain in pounds per man of six companies for six months. Only the men who have been weighed regularly are included in the calculation. Those who were absent from one of the weighings, attending hospital or for other reasons, have been excluded. Therefore we are dealing with the more healthy portion of each company. The total loss or gain at each weighing has been divided by the number of men weighed. The normal line is fixed by the first weighing, and along this line is shown the period during which the company was engaged in Physical Training and Gymnasium (P. T.), Company and Field Training (C. T.), and Musketry (M.). During the rest of the period the companies were doing ordinary duty, guards, parades, physical exercises two mornings a week and a weekly route march.

At the foot of the chart is the curve of the rainfall of Lebong during 1914. For the uncharted portion of the year the rainfall

is negligible, and during the month of October the weather was delightful.

The principal feature of the curves of weight is the very definite fall in July and August, and in every case the September weight is the lowest. I have not the least hesitation in attributing this to the climate, in other words to the rainfall. Conclusive evidence is afforded by the universal increase of weight in October, and by the great improvement in general health and appearance of the men during that month. I have no doubt that had it been possible to continue the observations the curves would have regained the normal line during the next few months.

It will be noticed that "E" Company's curve differs from the rest in showing a rise to the end of June. This may be explained by the fact that this company returned to Lebong on relief from Barrackpore towards the end of May. A number of "H" Company come under the same category.

Another point that will be noticed is the fall of "A" and "B" Companies' curves in April which is quite different from the others. These Companies occupied the lowest bungalows.

The Effect of Physical Training and Exercise.—Up to July 10, the course of Physical Training and Gymnasium (lasting three weeks) consisted of three parades a day, one three-quarters of an hour before breakfast and two three-quarters of an hour between breakfast and dinner. Acting on my recommendation the Commanding Officer reduced this by abolishing the early morning parade. Apart from the fact that the course is no doubt a strenuous one at such an altitude, I had two main reasons for my recommendation :—

(1) The distance between the bungalows and the parade ground. This particularly affected "A" and "B" Companies. The time between the first and second parades was just sufficient to allow these men to go down to their bungalows, snatch a hurried breakfast, and get back.

(2) The prevalence at that season of digestive troubles, chiefly a more or less mild form of diarrhœa, which tended to become chronic and had the character of hill diarrhœa.

For instance, during the physical training of "C" Company, 11 men lost over 5 lb. in weight, viz.: 6, lost 6 lb.; 1, 7 lb.; 3, 8 lb.; and 1, 9 lb. Seven of these had definitely been suffering from diarrhœa, 1 had an an attack of colic, and 1 had a sore throat and some bronchial trouble. Only 5 of them had reported sick.

"A," "B," "E," and "H" Companies, therefore, had a modified

course, "C" and "D" Companies and also "D" Company (May 2 to 19) had the full course. Of the four companies who did the modified course, 43 per cent lost weight and 46 per cent gained, and the average per man was a gain of 0·65 lb. Of the three other companies 54 per cent lost and 27 per cent gained, and the average per man was a loss of 0·95 lb. Though I am loth to place much value on these figures, I am inclined to think that the original course of physical training was rather strenuous. The balance in favour of the modified course is more evident when we remember the climate conditions before and after July 10.

As regards Company and Field Training there is no evidence from these weights that by itself the training has any bad effect. On the other hand, it serves to accentuate the point that the greatest effect is produced by the climate. There is no doubt that Company Training can be made very strenuous, as the only available training ground is up and down the khud, and it has been necessary to issue a caution on the occasion of a number of men falling out or coming sick directly as the result of a hard day's work.

It was the custom in 1913 to hold *Running Parades* during the rains. These consisted in alternately a double, a quick-time march, and a walk up the cart road for about one and a half miles. From what I gathered from the men I judged that these were the most trying of all their exercises. These parades were stopped in 1914.

The Route Marches in 1914 were considerably reduced in distance and the custom of marching the battalion straight up the short cut to Darjeeling was stopped.

Finally, as regards the effect of physical training, it is interesting to note that three of the four cases of beriberi came from "A" Company. Now it will be asked how can the total absence of the disease from "B" Company be explained, since two companies lived side by side in the group of four bungalows at the lowest and remotest part of the Cantonment, had practically the same food and went through the course of Physical Training together? The only explanation I can offer is that on the completion of their Physical Training at the end of July "B" Company had a month's rest, whereas "A" Company went straight on to Company Training, which lasted the whole of August, the most depressing season of the year.

Diarrhœa.—One very important cause of the loss of weight is the prevalence of digestive troubles, particularly diarrhœa, which presents the symptoms and characters of hill diarrhœa. This disease tends to become chronic, with two or three putty-coloured

stools first thing in the morning. It was rarely of a severe nature, and many of those attacked did not report sick and only a small proportion required admission to hospital. I have given above an

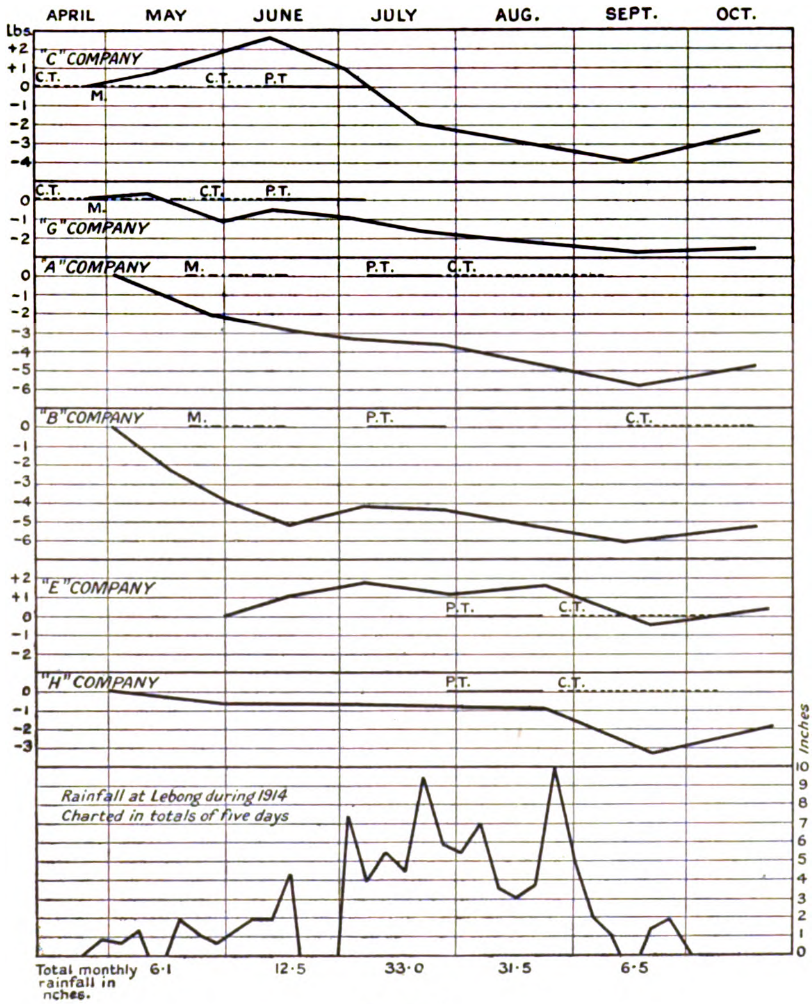


CHART I.

instance of the loss of weight produced in the persons of seven men of "C" Company and also amongst the "contacts."

The following tables, dealing as they do with the more severe cases only, give some idea of the prevalence of this disorder.

Table IV brings out the fact that "A" Company suffered most while "B" Company was nearly as bad.

TABLE IV.—CASES OF DIARRHŒA BY COMPANIES FOR EACH MONTH OF 1914.

	A	B	C	D	E	F	G	H
January, *nil*.								
February ..	..	..	..	..	..	..	1	1
March ..	..	..	..	..	..	..	1	..
April ..	..	1	..	..	..	..	..	..
May ..	1	..	..	*	..	*	..	..
June ..	1	2	1	..	..	..	3	1
July ..	12	11	4	..	3	..	7	5
August ..	5	3	2	..	..	..	..	...
September, *nil*.								
October, *nil*.								
	19	17	7	..	3	..	12	7

NOTE.—* "F" and 1/2 "D" went to Barrackpore.

TABLE V.—MONTHLY INCIDENCE OF DIARRHŒA DURING THE YEARS 1911-1914.

		1911	1912	1913	1914	Total
January, *nil*.						
February	..	..	1	..	2	3
March ..	..	..	..	..	1	1
April ..	..	2	..	2	1	5
May ..	..	2	5	6	1	14
June ..	..	78	14	5	8	105
July ..	..	23	9	20	42	94
August ..	..	9	8	8	10	35
September	..	7	3	3	..	13
October ..	..	4	2	1	..	7
November	..	..	2	3	..	5
December	..	..	2	..	..	2
		124	46	48	65	283

Table V shows the monthly incidence to be highest in June and July, and it is interesting to compare these figures with the beriberi figures in Table I. At first sight there seems to be a relationship between the two, but after a closer study and reference to statistics for previous years I think the relation is more apparent than real. However that may be, there is no doubt that we must reckon with this diarrhœa as an important cause of loss of weight, and therefore as a factor to be reckoned with as a predisposing cause of beriberi.

Judging from my own experience and that of other officers who have suffered from this complaint, the effects are very great. There is great debility, loss of weight (one officer lost eighteen pounds in a very short time) and impairment of digestion, only the lightest diet of milk and eggs being tolerated.

In the case of the men it is not by any means the rule for them

to report sick; they have two or three motions in the morning and then feel better and are just able to carry on for the rest of the day. At the same time their ordinary diet serves only to aggravate the symptoms and is not digested. This state of affairs may last some time, and the man loses weight and becomes debilitated and all exercise becomes an effort. Then one day being called upon to do a little more strenuous work such as a route march or an "attack" up the khud, he breaks down. When brought to hospital such a man will describle how he felt dizzy and breathless and felt his legs getting weak, and then he vomited.

On examination no symptoms beyond the diarrhœa and vomiting may be present, and with careful treatment and rest the patient may recover without any further developments. On the other hand, the knee-jerks may be absent or may disappear later, and there may be pain and tenderness of the calves and pain on pressure over the epigastrium. Even then no further symptoms may develop under appropriate treatment, but possibly in time undoubted symptoms of beriberi made their appearance.

The conclusions I would draw from these observations are :—

(1) That loss of weight is the rule during the summer and is directly the result of the rains.

(2) That with the advent of the rains digestive disorders become prevalent and have a very depressing influence.

(3) That physical exercise if regulated to suit the altitude is not in itself harmful, but may easily be overdone in the presence of (1) and (2).

(4) That consequently by the operation of (1), (2) and (3) we have a condition produced which predisposes to the development of symptoms of beriberi.

Research Work.

Owing to my many other duties I was unable to carry out any elaborate research, and my efforts were limited to an endeavour to find a causal organism.

Two post-mortems provided me with material. The first case contracted the disease in 1913 and relapsed in 1914 and died of acute dilatation and failure of the heart. The second contracted the disease in 1914 and has been reported above (Case 2).

With material from these post-mortems four monkeys (*M. rhesus*) were inoculated: three received into the peritoneum cerebrospinal fluid, saline emulsion of the medulla and emulsion of the mesenteric glands respectively, the fourth had fifteen minims of cerebro-spinal fluid injected into the spinal column by lumbar puncture.

All the animals showed some loss of weight, but this may have been due to the advent of a cold spell of weather, and one lost appetite and had diarrhœa for a short time; otherwise they remained perfectly well, and a short time after I left Lebong they were allowed to regain their freedom.

Further bacteriological examination of these two cases gave negative results. The microscopic examination of the blood, bile, cerebrospinal fluid, spleen and mesenteric glands revealed nothing. Likewise the cultures remained sterile or showed a few intestinal contaminations.

The pathological findings in each case were entirely those depending on the mechanical effects produced by dilatation of the heart. In the second case the whole of the intestines showed a fine arborescent injection and the mesenteric glands were prominent. Cultures from these glands produced only some common intestinal organisms.

From the vomit of a beriberi patient three bacilli were isolated on a McConkey plate, viz.:—

(1) A non-lactose fermenter turning glucose acid without gas and rendering the media fluorescent.

(2) A non-lactose fermenter and motile, in its reactions corresponding to *fæcalis alkaligenes* and agglutinated up to one in twenty dilutions of the patient's serum.

(3) A bacillus fermenting lactose, glucose, and mannite with gas (dulcite was not available).

I was struck with the large number of the chronic cases that suffered from bad teeth and pyorrhœa alveolaris; one case, a relapse from 1913, had this condition particularly well marked. He was one of the worst of the 1913 cases and had to be readmitted during 1914 with persistent vomiting. Microscopic examination of the vomit revealed quantities of saliva with threads of pus. When the mouth condition was energetically treated the vomiting ceased at once. In many of these cases there was present in the pus a very large bacillus, sometimes segmented and suggesting the mycelium of a fungus, but it was not by any means a constant feature.

Therefore, so far as these observations go, there was no indication of a causal organism, and this was to be expected if we were dealing with true beriberi. The object of the animal experiments detailed above was to eliminate the presence of a "filter passer," but of course the susceptibility of the monkey to the disease is an unknown quantity.

The dogs at Lebong suffer from a curious disease, the symptoms being fever, pains in the back and limbs, weakness of the legs and partial paralysis and loss of weight. Many develop cerebral symptoms and some cases have been mistaken for rabies. I had the opportunity of doing a post-mortem on one such dog, and found acute meningitis. The causal organism was a small streptococcus which grew very slowly and delicately on ordinary media. The dogs which I afterwards treated all recovered under the administration of calomel and a course of liq. hydrarg. perchlor. I mention this disease of dogs because it had been noted by former medical officers and mentioned in their reports as bearing some resemblance to beriberi.

Conclusions.

I think that it may be very fairly concluded—

(1) That the disease is beriberi.

(2) That no evidence of a specific organism has been obtained and there is no evidence that the disease is infectious or contagious.

(3) That the steps taken to prevent the disease at Lebong during 1914 have had a gratifying result. The regiment did not leave behind a single man on account of beriberi when it sailed for England.

(4) That the result has been attained in the first and foremost place by the improvement in the dietary, but also in no small degree by the attention paid to general health, hygienic surroundings and physical exercise.

(5) That climate, climatic diseases (diarrhœa) and physical exercise which is not regulated to meet the conditions obtained at Lebong are important factors in predisposing to beriberi.

Rules and recommendations have been drawn up for the future guidance of the troops at Lebong and it will be very interesting to see the result.

I desire to express my indebtedness to Lieutenant-Colonel J. C. Prettie Perry, R.A.M.C., the S.M.O. of the Station, for his hearty co-operation in the work and for his assistance and his many valuable suggestions, without which it would not have been possible to have brought the work to such a successful issue.

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REPORT FROM THE CEREBROSPINAL FEVER LABORATORY, CAMBRIDGE, JULY, 1915.

By Captain J. F. GASKELL, M.A., M.D., D.P.H.Cantab., F.R.C.P.Lond.

Royal Army Medical Corps (T.F.).

Introduction.

The special Cerebrospinal Fever Laboratory at Cambridge was opened on March 4. In order to make the report for the district as complete as possible, I am also including cases occurring before this date, many of whom were in the First Eastern General Hospital at that time, and whose puncture fluids had been sent to me for examination as Pathologist to the Hospital.

At the beginning of the special work on cerebrospinal fever, I found myself greatly hampered from want of an assistant to carry on the laboratory work while I was away visiting billets and taking swabs of contacts ; however, on March 10 Captain Hele very kindly agreed to put in all spare time at his disposal in assisting me, which he continued to do till the end of June. As he was doing this work, the Registrar of the First Eastern General Hospital excused him some of his other duties.

On March 22 I received still further assistance. Mr. Vines was appointed by the Insurance Act Research Committee to investigate the question of the identification of the meningococcus and problems arising therefrom. I put him in charge of the investigation of known strains of meningococci which were being obtained by lumbar puncture. The remarks on the biological characters of the strains of meningococci obtained, as also a considerable part of the work on the identification of the meningococcus obtained from the throat, must therefore be considered as a joint report. Captain Hele was mainly concerned with assisting me in analysing plate cultures obtained from throat swabs, and endeavouring to differentiate and classify the various Gram-negative diplococci found. He kept alive and under observation in subculture for some months many of the strains obtained, and was able to substantiate the constancy of such properties as sugar fermentation in the various groups.

The part of this report dealing with the differentiation of throat diplococci is therefore a joint report of Captain Hele and myself.

The number of cases personally dealt with up to the end of

June is thirty-eight, fifteen of whom died. All these cases were treated at some period of their illness at the First Eastern General Hospital, and all were proved bacteriologically by lumbar puncture.

In addition to these, three doubtful cases were admitted during June, being in all probability mild cases of the disease. Bacteriological proof by lumbar puncture could never be obtained, but in one case an organism apparently identical with the meningococcus was grown from a throat swab.

Three cases occurred who died before they could be admitted to the First Eastern General Hospital. One case, which presumably recovered, was seen in the Northampton Borough Hospital, and left under treatment there.

I have also been informed of three other cases primarily occurring in the district, who died early in the year, one at Bishop's Stortford, and two in the Highland Division, stationed at Bedford. The particulars of these three are here given, as they will not be further referred to in this report:—

(1) Private McI., 1626, 4th Gordons. January 28, First Southern General Hospital, Birmingham, influenza. February 15, Little Bromwich Hospital, C.S.M., March 4, died.

(2) Private T., 861, 6th Argyll and Sutherland Highlanders. March 1, Renfrew (home), from Bedford. March 9, died, C.S.M.

(3) Case died at Bishop's Stortford before February 20. No particulars are known to me.

The percentage of deaths among known cases treated at the First Eastern General Hospital is therefore 39·4 per cent.

If the three doubtful cases are also included, this falls to 36·6 per cent. If all known cases which have occurred in the district are included, the death-rate is 46·6 per cent, which falls to 43·8 per cent when the three doubtful cases are included.

Three convalescent cases were admitted from the Front. As they were well on arrival, and swabs of their throats proved negative, they will not be further referred to.

The method which I have adopted in dealing with cases in the district alloted to me will now be described. Arrangements were made with the Registrar of the First Eastern General Hospital so that, immediately a suspected case was notified, a motor ambulance was sent off and the patient was brought to the hospital and admitted to Ward 19, a portion of which was set apart for cerebrospinal fever cases. If considered justifiable a lumbar puncture was done as soon as possible. The puncture fluid was examined at once for pus cells and intracellular diplococci or other organisms,

but the diagnosis was never considered to be satisfactorily established till a culture of the meningococcus had been obtained.

While these investigations were being carried out, the medical officer of the unit to which the patient belonged was recommended to isolate the contacts of the case.[1] In certain districts, notably at Peterborough, this was most efficiently and satisfactorily done by making use of the local small-pox isolation hospital. In other places such accommodation was not available, but the medical officer in charge was advised to remove the contacts from the billet in which the case occurred to the largest and best ventilated accommodation available. On a case proving positive, a visit was made by motor, the billet was inspected, and swabs were taken of the contacts. The swabs were sown on the spot on to plates, which were spread on returning to the laboratory. With the assistance of Lieutenant-Colonel Woodhead, an efficient form of travelling incubator was made. The sterilizable plate-carrying case was carried in a close-fitting felt-lined tin, having double walls; the intervening space between these could be filled with water at 37° C., thus acting as a water-jacket to the central cavity. This tin was carried in a wicker basket lined with felt, padded with cotton-wool. The whole apparatus though somewhat bulky could be carried very conveniently in a motor car.

I have carried this apparatus in a car for eleven hours and the temperature has fallen less than 1° C. in that time.

The number of positive contacts in this district has been very small, so that it has been possible to deal with them as follows: They have been admitted to the First Eastern General Hospital and kept there till two throat swabs have proved negative. When the original swabs proved negative, contacts were released and allowed to resume their ordinary duties. Certain contacts from the Norwich district, who have been found repeatedly positive by Dr. Claridge, have also been admitted to the First Eastern General Hospital and have been dealt with by me.

This report will now be treated under the headings given in the scheme prepared in concert by the War Office Committee for Medical History of the War and the Medical Research Committee.

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[1] Contacts were taken to be all men who slept in the same billet, or hut, or who had been in close attendance on the patient after the onset of the disease for any length of time, short or long.

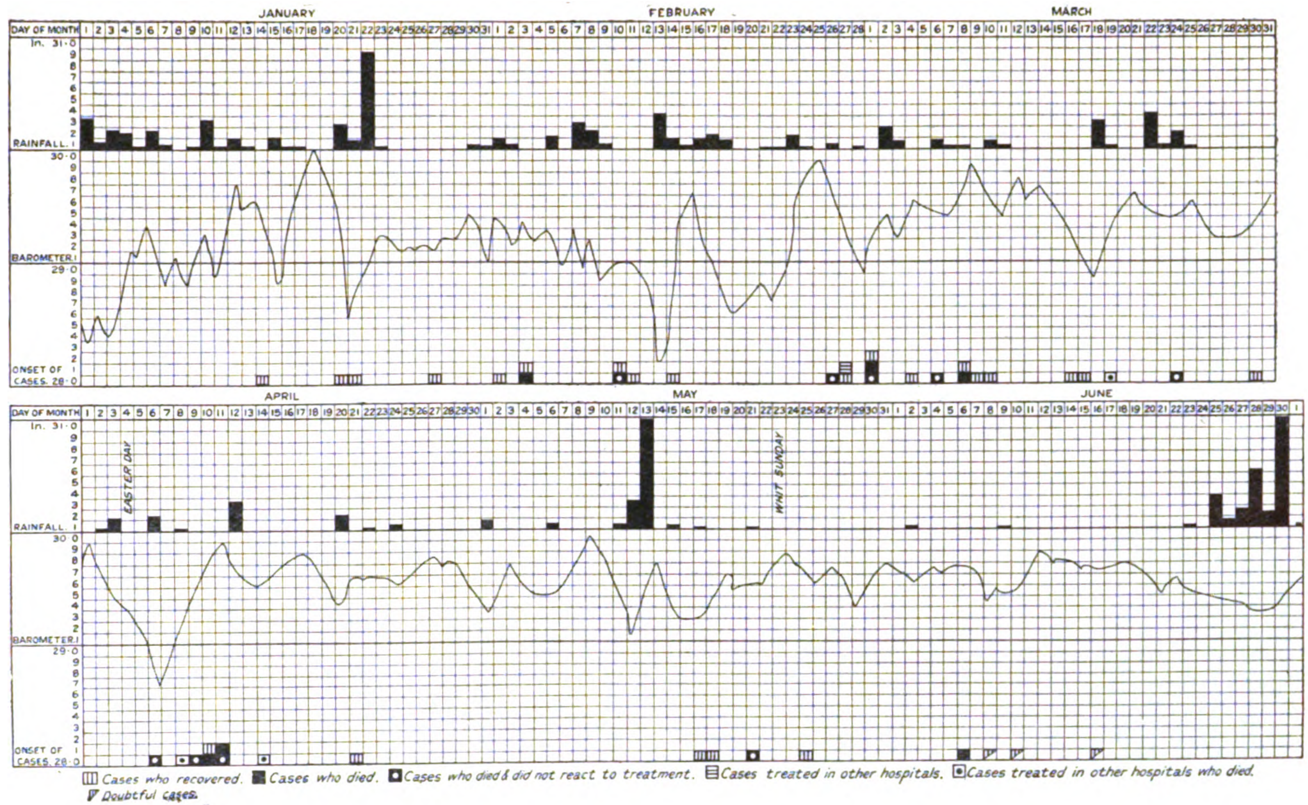

Chart showing for the first six months of the year 1915, the barometer reading and the rainfall in decimals of an inch at Cambridge, together with the date of onset of cases of cerebrospinal fever, which occurred in these months and are dealt with in this report.

I.—Mode of Spread of the Disease.

(*a*) *General Weather Conditions.*—A chart showing the dates of occurrence of cases, the barometer reading and rainfall in decimals of an inch at Cambridge is given in this report; the cases are noted on the day of onset, which in most cases has been quite clear. Usually the onset has been sudden, occurring more frequently in the evening than in the morning. On this chart those cases which have recovered, those which have died, and those which have not reacted in the slightest degree to treatment and have died within five days of onset, are indicated differently. In addition four which were never admitted to the First Eastern General Hospital are shown; of these, three died. Also three doubtful cases are recorded, shown by a triangular marking.

The number of cases is too few to enable any conclusion as to influence of weather conditions to be drawn. The cases have tended to occur on a falling barometer, but usually early in the fall, before the lowest reading has occurred. On the other hand, the largest group, which occurred in April, of eight cases in nine days, followed a very large fall of the barometer, when the subsequent rise was taking place. The lowest reading of the barometer obtained, on February 14, which was accompanied by prolonged rainfall and a very irregular barometer chart for the following days, did not bring on any number of cases, one case only occurring on the 14th itself.

Similarly, the relationship of rainfall to the occurrence of the disease is not very obvious. Twenty-nine cases occurred on days in which no rain fell at Cambridge, while only 16 occurred on days with rain. On the contrary, a conspicuously heavy rainfall, as on January 21 to 23, February 13 to 18, March 22 to 25, was followed by an absence of fresh cases. The recrudescence of the disease in May does seem to bear a slight relation to the heavy rainfall of May 11 to 13, but the first case of this group did not occur till four days later (May 17).

To sum up, there appears to be some relationship between unsettled weather, as shown by rapid variations in the barometer readings, and the incidence of the disease; cases tend to occur with a rapidly falling barometer. The influence of rainfall is apparently slight, but the rainfall at Cambridge is not necessarily an indication of the rainfall at the places where the cases occurred, such as Aylesbury and Maidenhead. Certainly the dry weather which started on April 13 was coincident with the suppression of the main outbreak in this district. The small fresh group of four

cases in May followed at some slight interval a marked group of rainy days, which occurred in the particular dry period in April May and June. It is thus possible that frequent wettings may act as a predisposing cause to the onset of the disease, by lowering the general well-being of the man temporarily—an effect to some extent comparable with that of a previous illness, which, as will be discussed later, seems to have been a factor in a number of the cases.

(*b*) *Particular Circumstances of Exposure to Infection.*—In the particular district with which I had to deal, namely Northamptonshire, Huntingdonshire, Cambridgeshire, Bedfordshire, Hertfordshire, and the Tring Division of Buckinghamshire, a particular focus of infection was not very obvious. Table I gives the distribution of cases for each station and the dates on which these occurred; the only places in which a considerable number of cases occurred are seen to be Bedford and Peterborough. The cases in both these towns are seen to be scattered fairly regularly throughout the early part of the year, and can hardly be looked upon as forming anything in the nature of an epidemic. The rest of the table is remarkable for the occurrence of only one or two cases in a particular locality, and if more than one, they are frequently separated by a prolonged interval. The small outbreak which occurred in the huts of the 11th Suffolks, stationed at Cherry Hinton, Cambridge, is of interest, as five cases occurred within a month; the conditions under which this outbreak took place will be dealt with in the next paragraph (*c*).

There is therefore nothing to point to any particular place in the district in which conditions were more favourable for infection than in any other.[1]

By far the larger number of cases occurred when the men were in their billets or huts, but in five cases the man became ill while on leave in his own home. The full details of each case are given in Table I. In the case of A., on leave for fourteen days when attacked, it is possible that infection took place at home; in the other four cases, those of R., M., Mt., and An., this possibility is to be borne in mind, though the first three had only been on leave three days; the last was doing his training by going to London daily and sleeping at home. The fact that R. and M.

[1] There was no other series at all comparable with that at Cherry Hinton. I am fully aware that in the absence of any statement of the number of troops at any place, which I am unable to supply, this remark can only be taken as representing an opinion.

both became ill at Littleport within eight days of each other may have been due to their infection on arrival at Littleport from some local source there.

In some other cases the possibility of infection while on leave must be considered. In ten cases it was ascertained that the men had not been on leave at all for over a fortnight, but in eleven cases fairly recent leave had been given or the men had been recently shifted from some other district.

If it is allowed that infection took place during this leave, the following places would be eliminated as sources of infection: Bishop's Stortford, Houghton Regis, St. Albans and Saffron Walden. It is of interest in this connexion to note that in 6 cases the men were on leave in places in which considerable numbers of cases have, I believe, occurred—in 2 cases Birmingham, in 3 cases some part of London, and in 1 case Norwich.

The question of leave is brought out very strongly in the group of exceedingly fatal cases in April; out of 9 cases in the month, in 6 a history of recent leave was obtained, and in the other 3 no particulars were got. None of these 3 men was ascertained not to have had recent leave. In 5 cases the disease appeared within two days of the man's return from leave, a point which is worth considering when discussing the question of the incubation period.

Another question also arises in regard to the particular circumstances of exposure, viz., the debilitating influence of a previous illness. I am strongly of opinion that the previous illnesses observed were not an early mild stage of cerebrospinal fever itself, but were correctly diagnosed, and acted as a predisposing cause for the later, often extremely acute, commencement of the attack of cerebrospinal fever.

The particulars are given in the final column in Tables II and III. In six cases a definite previous illness had occurred, in five of which the man had recovered sufficiently to be sent home on sick leave (Table I).

I therefore regard the lowered health thus produced as also acting as a predisposing factor in some cases. One other point has also cropped up. Three cases have occurred in men recently inoculated against typhoid fever. In the case of J., this had taken place twelve days before, and is therefore probably negligible; in the case of D., the second inoculation had taken place four days previously, and in the case of Y. the first inoculation was practically coincident with the onset of the disease. Seeing that

very large numbers of troops were being inoculated at the time of the main incidence of cerebrospinal fever, it is almost impossible to regard these cases as more than coincidences; it is just conceivable, however, that in these cases the malaise following inoculation may have been a contributory cause to the ease of infection.

TABLE I.

Station	First day's illness	Name	Previous leave. Days before	Dates	Place
Amersham, Bucks ..	1·3	C.	?	..	..
Bedford	26·2	My.	None	..	..
,, ...	27·2	Wg.	?	..	..
,, ...	6·3	Ht.	None	..	..
,, ...	8·3	Js.	?	..	..
,, ...	10·4	Rw.	?	..	..
,, ...	25·5	Ty.	Visited by	friends the	day before.
,, ...	8·6	O.	13 days	22.5 to 26.5	Ashford, Kent.
Bishop's Stortford ..	14·4	Br.	1 day	10.4 to 14.4	Unknown.
Cambridge	14·1	B.	?	..	..
,, ...	20·1	Rk.	?	..	..
,, ...	21·1	Jh.	?	..	..
,, ...	1·2	Ak.	?	..	..
,, ...	10·2	Hs.	?	..	..
Diss, Norfolk ..	9·4	F.	See Dr.	Claridge's re	port.
Fenny Stratford ..	9·3	H.	None	..	..
Hemel Hempstead ..	16·6	Me.	?	..	..
High Wycombe ..	10·2	G.	?	..	..
Houghton Regis ..	6·4	Bd.	1 day	1.4 to 5.4	Birmingham.
,, ..	21·5	Dn.	7 days	Moved from	Hitchin.
Kettering	1·3	Wr.	None	..	..
Littleport	3·2	R.	4 days	On leave	from Bury.
,, ...	11·2	M.	3 days	On leave from	Felixstowe.
Maidenhead ..	10·3	Tp.	None	..	..
Northampton ..	27·2	Hk.	?	..	..
,, ..	16·3	Tu.	1 day	13.3 to 16.3	Birmingham.
,, ..	24·3	As.	?	..	..
,, ..	18·5	Wd.	None	..	..
Peterborough ..	3·2	Ss.	?	..	..
,, ..	4·3	St.	2 days	27.2 to 2.3	Norwich.
,, ..	17·3	N.	14 days	3.3	Unknown.
,, ..	30·3	Tm.	None	..	..
,, ..	8·4	Gr.	?	..	..
,, ..	10·4	D.	12 days	26.3 to 29.3	Docking, Norfolk.
St. Alban's	21·4	Sw.	4 days	17.4 only	Bermondsey.
Saffron Walden ..	14·2	Bo.	7 days	For firing	Luton.
Stansted	27·1	Mr.	?	..	..
Towcester	8·3	Y.	None	..	..
,, ...	19·3	Ct.	None	..	..
Watford	11·4	An.	Daily to	London for	drill.
,, ...	11·4	J.	1 day	5.4 to 10.4	Streatham.
,, ...	17·5	Yg.	None	..	..
Whittlesford, Cambs	1·3	A.	14 days on	leave from	Bury St. Edmunds.
Wilburton, Cambs ..	10·6	Cl.	?	..	..
Worthing, Norfolk ..	6·6	Mt.	3 days on	leave from	Colchester.

TABLE II.

Recovered. Name	Date of onset	Days to admission	Length of illness	Days in hospital	Age	Length of service	Catarrh at onset	Cubic space in billet per man	Floor space per man	Ventilation area per man	Number of contacts	Fatigue	Previous illness
Tm. ..	30.3	1	11 days	73	17	5 months	No	468	52	3	1	No	No.
Rk. ..	20.1	1	11 ,,	18	27	10 weeks ..	,,	C.H.	C.H.	C.H.	?	,,	,,
H. ..	9.3	3	15 ,,	48	20	7 months	Yes	322	40		7	,,	,,
Ty. ..	25.5	1	15 ,,	52	19	7 ,,	No	327	38·5	1½	3	,,	,,
Wg. ..	27.2	5	21 ,,	72	17	7 ,,	?	400	50	1½	6	,,	Influenza, 22.2 to 26.2.
Wd. ..	18.5	3	22 ,,	74	18	9 ,,	No	493	58	1¼	1	,,	No.
Yg. ..	17.5	5	25 ,,	55	26	6 ,,	,,	540	60	4	4	Yes	,,
Wr. ..	1.3	9	25 ,,	54	23	4 ,,	,,	576	72	1½	1	No	,,
Tp. ..	10.3	4	26 ,,	50	19	7 ,,	,,	459	54	4	1	,,	,,
*Mr.** ..	27.1	28	28 ,,	10	21	7 years ..	,,	?	?	?	?	?	?
Bo. ..	14.2	3	30 ,,	71	18	6 months	,,	197	26	1	3	No	No.
*G.** ..	10.2	27	32 ,,	48	38	4 ,,	,,	?	?	?	?	?	?
Sw. ..	21.4	3	36 ,,	40	26	4 years ..	,,	525	60	3¾	2	No	No.
N. ..	17.3	3	38 ,,	43	19	6 months	,,	866	97	4½	1	,,	,,
St. ..	4.3	7	41 ,,	53	21	6 ,,	,,	470	55	3	7	,,	Sore throat, 7.2 to 27.2.
Ak. ..	1.2	4	48 ,,	87	22	4 months	,,	C.H.	C.H.	C.H.	?	Chronic ill-health	No.
R. ..	3.2	30	56 ,,	61	22	6 ,,	,,	Home	Home	Home	?	No	,,
Js. ..	8.3	7	62 ,,	76	27	5 ,,	?	?	?	?	None	?	?
M. ..	11.2	29	64 ,,	59	24	3 ,,	No	Home	Home	Home	,,	?	?
B. ..	14.1	9	72 ,,	94	19	?	?	C.H.	C.H.	C.H.	?	?	?
Tu. ..	16.3	1	86 ,,	137	26	6 months	No	765	90	5	1	No	Influenza, 2.3 to 7.3.
Rw. ..	10.4	5	100 ,,	106	23	6 ,,	,,	?	?	?	None	?	No.
Jh. ..	21.1	8	102 ,,	94	17	3 ,,	,,	C.H.	C.H.	C.H.	?	?	?
Doubtful Cases.													
Cl. ..	10.6	1	11 days	34	20	7 months	No	C.H.	C.H.	C.H.	?	No	No.
O. ..	8.6	2	26 ,,	51	19	8 ,,	,,	240	30	1½	5	,,	,,
Me. ..	16.6	5	26 ,,	40	28	6 years ..	,,	?	?	?	?	?	?
Cases Treated Elsewhere.													
Hk. ..	27.2	..	Treated at Northampton Borough Hospital				No	352	44	3½	1	No	No.

* Convalescent on admission.

C.H. = Cherry Hinton huts, Cambridge.

TABLE III.—Fatal Cases.

Died. Name	Date of onset	Days to admission	Length of illness	Days in hospital	Age	Length of service	Catarrh at onset	Cubic space in billet per man	Floor space per man	Ventilation area per man	Number of contacts	Fatigue	Previous illness
Bd. ..	6.4	Days 1	36 hours	Hours 12	20	6 months	No	333	33	⅔ sq. ft.	8	No	No.
Hs. ..	10.2	Hours 12	1½ days	Days 1	36	3 ,,	,,	C.H.	C.H.	C.H.	?	?	?
As. ..	24.3	Days 2	4 ,,	2	21	3 years ..	?	?	?	?	2	?	?
C. ..	1.3	3	4 ,,	1	?	?	?	440	52	*Nil*	8	?	?
J. ..	11.4	1	5 ,,	4	34	2 years ..	No	380	45	2½	6	No	Inoculation 12 days.
Dn. ..	21.5	1	5 ,,	4	19	7 weeks ..	,,	Army tent	..	..	10	,,	No.
F. ..	9.4	3	5 ,,	2	19	1 year ..	See Dr. Claridge's Report.						
Ht. ..	6.3	4	5 ,,	1	18	2 years ..	No	Good	..	Good	?	?	Convalescent from measles.
My. ..	26.2	2	5 ,,	3	24	?	,,	375	50	4½	1	No	No.
Mt. ..	6.6	11	15 ,,	4	41	10 months	,,	Home	..	Home	30	,,	,,
Ss. ..	3.2	4	19 ,,	15	17	3 ,,	,,	?	?	?	?	?	?
An. ..	11.4	2	23 ,,	21	17	4 weeks ..	,,	995	117	7½	2	?	?
A. ..	1.3	4	49 R.*	45	21	29 ,,	,,	Home ,,	Home	Home ,,	?	No	Influenza: home 7 days.
D. ..	10.4	4	51 days	47	20	3 months	,,	640	80	5½	13	Inoculation, 6.4	Cold 29.3, 12 days.
Y. ..	8.3	4	63 ,,	60	22	5 weeks ..	Yes	480	60	1	2	Inoculation, 8.3	No.

TABLE IIIa.—Fatal Cases not admitted to First Eastern General Hospital.

Died. Name	Date of onset	Length of illness	Age	Catarrh at onset	Cubic space in billet per man	Floor space, per man	Ventilation area per man	Number of contacts	Fatigue	Previous illness
Br.	14.4	5 days	?	No	322	46	2¼	2	No	10.4. Not quite well.
Ct.	19.3	1½ ,,	?	Yes	540	72	4	1	No	No.
Gr.	8.4	12 hours	?	No	576	72	1½	1	No	No.

* R = Relapse. C.H. = Cherry Hinton huts, Cambridge.

To sum up: there is a distinct connexion between the giving of leave and the incidence of cases in this district, men thus becoming exposed to infection and either developing the disease while on leave or within a fairly short time after returning—in some cases almost immediately after. A previous illness also is a factor in predisposing any particular individual to an attack, acting by reducing resistance in the same way that weather conditions, already discussed, also do.

(*c*) *Overcrowding and Lack of Adequate Ventilation.*—The cubic space per man found in billets and the ventilating area are given in each case in Tables II and III. The number of cases in which this cubic space has been ascertained to be 400 cubic feet or less is 11; the number in which it has been above this is 15. In this latter group, however, in 1 case the ventilation was practically *nil*, the men being billeted in a garage; in 4 cases the ventilating area was below 2 square feet per man, and in 3 other cases it was below 4 square feet. In only 7 cases of the 26 in billets were the conditions of cubic space and ventilation adequate. In one of these, at any rate (Tu.), the man had returned the day before from sick leave following an attack of influenza; the billet conditions had therefore little to do with his attack.

The conditions in the huts at Cherry Hinton, Cambridge, in which the cases in the 11th Suffolk Regiment occurred, are interesting; the letters C.H. in Tables II and III refer to these huts. The cubic space per man was 200 cubic feet, 30 men being in each hut and the ventilation area 2 square feet per man. Five cases occurred here within a month very early on in the year (*see* Table I); and during this period facilities available for ventilation were little made use of. Lieutenant-Colonel Woodhead, however, took the matter in hand and secured adequate ventilation, with the result that the disease completely ceased, and no further cases were observed through the rest of the period in which cases were occurring elsewhere. I conclude, therefore, that insufficient cubic space per man and inadequate ventilation are powerful predisposing causes.

(*d*) *Fatigue.*—This factor is also tabulated in Tables II and III, and is, in my opinion, of very little importance.

In almost all cases the men had been carrying out their ordinary duties and had had no extraordinarily hard work. In one case, Ak., the man had been in chronic ill-health and therefore was liable to be easily over-fatigued. In the case of Yg., his regiment was marching from Watford to Saffron Waldron, and Yg. was taken severely

ill on the way. He was, however, already out of health on the day he started from Watford. Fatigue, therefore, seems of little importance.

(*e*) *Age of Patient.*—As is seen in Tables II and III the ages range from 17 to 42. Twenty-three cases occurred in men between the ages of 17 and 22, of whom 9 died; 13 occurred in men between the ages of 22 and 30, of whom 2 died; and 4 between the ages of 34 and 42, of whom 3 died.

As the number of young recruits in the forces stationed in my district considerably outnumbered men of a more mature age, little can be argued concerning susceptibility according to age; on the whole it is probable that the percentage incidence was fairly uniform. The death-rate, however, varies considerably, being 40 per cent. under 22, and only 15 per cent. between 22 and 30.

Among the few older cases, however, it is high, being 75 per cent. It appears, therefore, that the chances of recovery increase with arrival at full maturity, while over 30 years they again diminish. The figures are small as a basis of inference, but the percentage difference is large.

(*f*) *Length of Service in the Army.*—This is also tabulated in Tables II and III, and ranges from four weeks to seven years. Of those under four months' service 6 out of 9 died, while among those of longer service, but recruited since the outbreak of war, only 2 out of 20 died. The outlook is apparently worse, therefore, in fairly recent recruits. The incidence of the disease does not appear to depend on the length of service in any way.

(*g*) *Catarrh* is, in my opinion, not a predisposing factor, and the catarrhal stage of the disease, as described by the Aldershot workers, is remarkable by its absence. In only one case, that of Corporal H. was there any definite sore throat at the onset. The remarkable thing about many cases was the extreme suddenness of definite meningeal symptoms in a man previously absolutely well.

II.—Contacts.

The identification of the meningococcus from the throat is a matter of difficulty in our experience. The tests recommended have been mainly relied on, namely the power of growth at 23° C. and the power to ferment glucose and not saccharose. Other sugars have also been tried and will be referred to later.

We do not consider for many reasons that these methods are in our hands entirely satisfactory.

We have studied, often for months, the properties of various

strains of meningococci obtained by lumbar puncture, and have used them for comparison with organisms obtained from the throat. With one exception all these meningococcus strains have been uniform in fermenting glucose in fluid solution to a greater or less degree, that is to say, to an extent which is identifiable with certainty if control tubes are used. The one case (Tu.), a strain of which has been submitted to the laboratory at the Royal Army Medical College, for a long time did not ferment glucose. After about three months' artificial cultivation, however, it gradually gained, or rather manifested, the power to do so. The probable explanation of this will be discussed later, when treating of the nature of the sugar reaction.

A few difficulties met with will first be discussed, and then the value and reliability of the tests.

(1) *Vitality.*

An initial difficulty was found to be the successful subculture of a particular strain. This holds not only for the meningococcus but also for other types of Gram-negative diplococci as well. If sown from the culture in the ordinary way in minimal amounts the subculture usually fails to grow. If, however, a large amount sufficient to cover the needle is taken, subcultures can almost always be successfully obtained. Another point is to select a tube or plate freshly made with plenty of moisture—a subculture has often failed owing to the tube on which it was made being too dry. The difficulty mainly arises when the strain is first obtained, and it is worthy of note that it has practically never arisen in the tube in which the first sowing from a plate has taken place, but quite frequently at the second subculture. However, with the precaution of sowing very thickly on to a moist tube strains practically never fail to subculture. With the media supplied, the only safe method to preserve a strain has been daily subculture. We, however, now find that a cornflour starch medium, recommended by Vedder, and suggested to us by Dr. Flexner, of New York, will keep the organisms alive on slopes for four to six days and in stabs for as long as a fortnight.

(2) *Streptococcal Contamination.*

Owing to the necessity of subculture in mass it has frequently been extremely difficult to eliminate streptococcal contamination.

As these organisms ferment both glucose and saccharose with rapidity, errors in fermentation tests can only be safeguarded by always subculturing at a suitable interval the sugar tubes used.

(3) *Constant Temperature in the 23° C. Incubator.*

Unless checked by keeping a chart of readings of a maximum and minimum thermometer, quite large variations in temperature may be missed, especially at night. This was a source of error early in our work.

(4) *Want of a really Successful, Constant and Easily Sterilizable Sugar Solution.*

In our experience the mixture recommended in Major Gordon's report is an extremely tricky one to make up satisfactorily with certainty, more especially in the case of glucose. The trouble appears to be the exact point in neutrality necessary for successful sterilization and to prevent subsequent alteration in colour on incubation. Frequently two or three days' incubation changed the original blue colour of the litmus to a dirty brownish-blue, in which small changes of acidity, such as many meningococci give, are very difficult to detect. This may partly depend on the glucose used; for instance, a sample sent us from the Royal Army Medical Corps store at Woolwich was absolutely useless, becoming strongly acid merely as the result of a day's incubation. As the meningococcus reaction takes on the average four days to become undoubtedly plain, this question of slow breakdown of sugar solutions is a very important one. The addition of fresh serum also renders the possibility of contamination a factor, but by making use of the sterilizable bulb filler invented by Dr. Cobbett we have had no trouble from this source, with the exception of the occasional use of serum already contaminated in bulk.

The complicated proteid mixture present, lemco or veal broth, peptone and fresh serum, when such a delicate reaction is being tested, is eminently undesirable, and considerable numbers of experiments have been undertaken in an attempt to improve on this. We are now working on a cornflour starch mixture which is promising, has the advantages of comparative simplicity, an easily obtainable sky-blue colour, and can also be sterilized completely in the same manner as peptone water sugars.

(5) *The Slowness of the Reaction of Sugar Media with both Meningococci and certain other Groups.*

We endeavoured to overcome this by making use of a different indicator, using neutral red instead of litmus, as its neutral point is much more on the alkaline side and much sharper than that of litmus. While this indicator showed change two or three times as quickly as litmus, it was not found that the change of colour was sufficiently distinctive in certain groups. It distinguished quickly the groups that we call *pharyngis siccus*, von Lingelsheim, and *flavus I*, the change being complete overnight, but in the other groups the change was not sufficiently marked to be absolutely reliable. It is, however, of some value in quickly eliminating the groups mentioned. An additional drawback is that the strain of *Micrococcus catarrhalis* that we used also caused a slight acid reaction in glucose with this indicator. This will be further referred to in discussing the nature of the sugar reactions. Solid media were also to some extent tried, but were found to be even less reliable than the fluid media, so their use was abandoned.

Growth in the Cold Incubator at 23° *C.*—In our experience this is a useful help to differentiation, but is open to fallacies, and taken by itself cannot be a safe guide.

The occurrence of *copious* growth at this temperature overnight or within two days is sufficient to eliminate any particular organism, but for the differentiation of the more difficult groups it is, in our experience, merely confusing.

For instance, some strains of meningococci when first obtained undoubtedly showed slight growth in forty-eight hours, more especially if sown on blood agar. The growth, though slight, was quite distinct. On the other hand, certain individuals in the groups we call *flavus II* and *III* have shown no growth at a lower temperature than 24° C. and only grow feebly between 24° C. and 25° C.

It may also be mentioned here that constant subculture at 37° C. has definitely removed the power to grow at 23° C. in practically the whole group of Gram-negative diplococci which have been obtained from the throat and studied. A series of thirty-two strains belonging to different groups have been under study for some weeks, the longest having been under culture for over four months, and except in the group *flavus I*, in which feeble growth occurred in three to four days, the amount of growth was negligible. On transference to the 37° C. incubator on the fifth day, luxuriant growth was obtained in all tubes.

The minimal temperature for a particular organism of the Gram-negative group is therefore a variable factor. Another fallacy, which may occur in using the cold incubator test, is due to the question of the vitality of the subculture and the necessity of thick sowing. This has been guarded against by always transferring tubes back to the hot incubator on the third day, and only counting the test satisfactory if growth then occurs. All strains of meningococci met with grow freely in the hot incubator after having been in the cold three days.

Differentiation by the Sugar Reactions.—This is the method which has been mainly relied on, and the following provisional classification has been made of the group of Gram-negative diplococci as found in the posterior pharynx; the groups are given and also their sugar reactions. Thirty-two organisms have been selected and thoroughly and frequently tested over a prolonged period:—

	Glucose		Saccharose		Mannose		Galactose		Inulin	
Organism	Reaction	Time in days	Reaction	Time in days	Reaction	Time in days	Reaction	Time in days	Reaction	Time in days
M. pharyngis siccus	+	1	+	1	+	1	–		–	
M. flavus I ..	+	1 or 2	+	2	+	3	–		–	
,, *II* ..	+	4	+	4	+	4	–		–	
,, *III* ..	+	3 or 4	a	..	+	3 or 4	–		–	
M. catarrhalis	a	..	a	..	a	..	–		–	
Meningococcus	+	4	a	..	{ + / a	3 / 7 }	–		–	

+ = acid. a = alkaline. – = no change.

M. pharyngis siccus is an extremely adherent organism, growing freely on the media used, and often in a young culture forming a skin which can be removed off the surface of the colony. Later the whole colony becomes densely adherent. These characters may be lost quite quickly on subculture and the culture resemble closely that of a meningococcus. The colour is white. It grows freely in the cold at 23° C. and ferments glucose, saccharose, and mannose with rapidity, the reaction usually being practically complete in twenty-four hours. Under a low power of the microscope the colony is a clear orange brown.

M. flavus I.—Yellow in colour. The colonies tend to slide about over the surface of the medium and can be picked up whole by the needle. In some of this group, however, the organism has a more stringy growth, fairly easy to get on the needle but difficult to sow off again. It grows freely in the cold at 23° C., and ferments glucose, saccharose, and mannose, but not so rapidly as *M. pharyngis*

siccus. Usually the reaction takes two to three days to be complete, though showing in glucose in twenty-four hours as a rule.

M. flavus II differs from the preceding group in being much more delicate, and fermenting the sugars much more slowly and often less completely.

It is also yellow in colour. The colonies tend to coalesce into a rather sticky mass, often coming away in strings when touched by the needle; it is, however, usually easier to sow off than similar organisms of the group *flavus* I. It grows feebly in the cold at 23° C. in forty-eight hours. It ferments glucose, saccharose and mannose, but no distinct change is often apparent under three to four days, the time of reaction approximating to that of the two groups *flavus III* and the meningococcus. Often the change is first apparent in the saccharose tube rather than the glucose one, probably owing to the greater ease with which a satisfactory saccharose tube can be made.

This organism is comparatively rare—only having been met with on three occasions for certain.

M. flavus III.—Yellow in colour, but usually more of a canary-yellow than *flavus I* and *II*. The consistency of a colony resembles paint, and is thus very like that of the meningococcus.

With respect to its growth in the cold at 23° C. a subdivision may be made, *IIIa* growing strongly in the cold in twenty-four hours, *IIIb* refusing to grow at all at 23° C. and only growing slightly at 24° to 25° C. It ferments glucose and mannose, the reaction being evident in four days, but does not ferment saccharose.

M. catarrhalis.—This organism was only met with early in the investigation, and only one strain survived to be put through extended tests. Growth is like paint, easily emulsified in water. The colour is white. In the cold at 23° C. its power of growth was at first small, doubtful results only being obtained. Later after subculture for some weeks it failed to show any growth in forty-eight hours.

It did not ferment any of the sugars, though a slight temporary change became sometimes evident in glucose tubes on the third day. Both glucose and saccharose tubes were by the fourth or fifth day markedly alkaline.

Meningococcus.—The growth is like paint, easily emulsified, and the colour is white or very faintly tinged with yellow. In the cold at 23° C. it usually does not grow at all, but slight growth has been occasionally observed. It ferments glucose in about four days but not saccharose. The reaction with mannose is of interest as it

apparently differentiates it quite distinctly from *flavus III*. At first in about three or four days a slight but distinct acidity appears, later in six or seven days this has completely disappeared, and the tube may even become more alkaline than the control.

The acid change is always temporary and always slight.

The Sugar Used.

(1) *Glucose.*—The reactions of the various groups have already been given, all fermenting glucose except *M. catarrhalis.*

The difficulties in getting an efficient mixture have already been touched on.

(2) *Saccharose.*—Fermented by *flavus I* and *II* and *M. pharyngis siccus*; not by any of the others.

Never any serious difficulty in getting a good medium.

(3) *Mannose.*—The sample used was Kahlbaum's. Fermented by *M. pharyngis siccus*, *flavus I, II* and *III* but not by the meningococcus to any extent. Not by *catarrhalis.*

The experiments with mannose are at present few, and the value of this sugar to differentiate the meningococcus and *flavus III* is to be further tested.

(4) *Galactose.* — Specially made and purified by Professor Hopkins, of the Biochemical Laboratory, to whom our best thanks are due. We have tested this sugar on our strains three times in all, and have never found the slightest sign of fermentation with any Gram-negative diplococcus even at the end of a week. The organisms all grew well, and subcultured freely out of the medium. We therefore are in agreement with Elser and Huntoon on this point, and presume that the positive results obtained by other workers are due to difficulties in getting a reliable medium. We have ourselves found that still greater care is necessary with this sugar than is the case with glucose.

(5) *Inulin.*—This was tried as the power of the meningococcus to grow on starch was found to be so marked. The results were throughout negative.

We are well aware that the differentiation, as far as throat organisms are concerned, is incomplete, and that other organisms, such as the pseudo-meningococcus, are included in our meningococcus group. We are therefore hoping to investigate the removal of agglutinating power, which in the hands of Elser and Huntoon seemed to be of considerable value.

The differentiation by fermentation is, however, probably good enough for practical purposes, as the organisms which would be

included wrongly in the meningococcus group are not widespread.

By far the greater number of the Gram-negative cocci met with fall in the first two groups *pharyngis siccus* and *flavus I*, which are both easily eliminated.

The direct differentiation on the primary plate by means of incorporating glucose and neutral red has been advocated by Buchanan, but our experience leads us to believe that this method is open to grave objection, and has many fallacies.

Our working method is, therefore, to get a pure culture, and then sow in bulk into glucose and saccharose broth. A culture is also sown on a slope and put in the cold incubator. A stock culture is also made in a starch stab in case further tests are necessary.

On the second or third day a subculture is made from the broth tubes to establish growth in them of the pure organism, and if no growth is apparent on the tube in the cold incubator, this is then transferred to the hot incubator to be sure the culture is alive. If the organism gives the sugar reaction of the groups *flavus III* or meningococcus, it is also sown into mannose. By the summation of the results of these tests the organism can usually be differentiated accurately. In our opinion the whole of these tests must be rigidly performed in the case of a doubtful organism.

The groups *M. pharyngis siccus* and *flavus I* are, of course, easily eliminated with certainty by the sugar tests or cold test alone.

As has already been mentioned, we do not consider the sugar media entirely satisfactory, and think that there is room for improvement in this direction.

The differentiation of the meningococcus from closely allied organisms, such as pseudo-meningococcus, also is desirable. The differentiation of the meningococcus and *M. catarrhalis* also is a matter open to argument, more especially in the light of the occurrence of diplococci from the fluid of true cases of cerebrospinal fever, such as that of Tu. in one series, which do not ferment glucose. The cold incubator test is also not conclusive, as the few strains of *catarrhalis* that we have tested have grown very feebly at 23° C. Investigations that Mr. Vines is now making on the nature of the ferment action of these organisms may throw further light on this matter.

The present position of this research may be briefly sketched. It has been found that meningococci grown in a fluid medium similar to that used for testing sugars, but with the sugar left out

and just distinctly acid in reaction, in the course of a week or ten days commence to turn the medium more and more alkaline. The strain from Tu. was notably rapid in doing this, about twice as quick as any of the others tested. This alkali production is in all probability due to proteolysis, whether due partly to an extracellular ferment or not is at present uncertain.

On the other hand, from sugar tubes in which fermentation of glucose has taken place, a ferment can be separated which will cause acid production from glucose in a sterile medium, the sterility being checked from time to time by subculture. By the processes employed the bodies of bacteria are almost entirely removed.

It appears, therefore, that in a sugar fluid medium a double action is going on: an acid production from sugar due to an extracellular ferment and an alkali production from the protein present. The curious case of Tu. could thus be explained, the unusually rapid production of alkali masking the acid ferment reaction. It is possible also that *M. catarrhalis* has a similar double fermentative power, and that the alkali production is still more rapid. Indications have already been given that a slight acid reaction may appear in the early days of the fermentation. At any rate, the production of a strong alkaline reaction is a very marked feature of the growth of *M. catarrhalis* in glucose broth, and occurs very early. Further researches on these lines are being carried on.

The agglutination reactions of a number of strains of meningococci have been also studied by Mr. Vines by the macroscopical method, and the reactions at the end of four days are shown in the accompanying Table IV. The strains were tested against a polyvalent serum kindly sent me by Dr. Flexner from the Rockefeller Institute in New York, against a serum of one of the patients (D.'s serum) and against Mr. Vines' own serum, which was taken as a normal serum.

As is seen in the table the results with the different strains vary considerably. With normal serum only one, however, was completely agglutinated at a dilution of 1 in 10, and it is remarkable that this strain was also only agglutinated by the Rockefeller serum at the same dilution though tried twice. With D.'s serum, however, complete agglutination was also obtained at a dilution of 1 in 100. Both the Rockefeller and D.'s serum agglutinated all strains at 1 in 10 except in one case with D.'s serum. At 1 in 100 D.'s serum agglutinated all but three completely, while the

Rockefeller failed completely to agglutinate seven. At 1 in 1,000 complete agglutination occurred three times with D.'s serum and not at all with the Rockefeller serum.

TABLE IV.

B. *Final result. Agglutination.*

Strain	Rockfeller serum				D.'s serum			Normal serum			Time = 4 days
	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{500}$	$\frac{1}{1000}$	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	Notes
D. ..	+	+		p	+	+	+	s	s	s	Chronic case.
J. ..	+	+		−	+	+	+	p	s	s	Acute case.
An. ..	+	+	p	..	+	+	−	s	s	s	Chronic case.
A. ..	+	p	..	s	+	+	p	p	p	s	Chronic case.
As. ..	+	p	..	s	+	+	+	p	s	s	Acute case.
	+	+	..	p							
F. ..	+	p	..	s	+	+	p	p	s	−	Acute case.
Sw. ..	+	+	..	p	+	p	s	s	−	−	Chronic case.
Tm. ..	+	−	..	−	+	+	p	+	p	s	Mild case.
	+	s	..	−							
N. ..	+	p	..	s	+	p	s	p	p	s	Mild case.
Rw. ..	+	p	..	p	p	p	s	p	s	−	Chronic case? Sugar reactions.
Tu. ..	+	+	..	−	+	+	p	p	s	s	Chronic. No sugar reactions.
Bd. ..	+	+	..	−	..	..	..	..	..	..	Acute case.
Tm. throat	+	p	..	s	+	+	p	p	s	s	Mild case.

+ = complete reaction. p = partial. s = slight. − = no reaction.

The results obtained vary so considerably among these known meningococcal strains that all idea of using the agglutination reaction for the differentiation of throat cocci was abandoned. Our conclusions are thus in agreement with those of Gordon, Elser and Huntoon and many other workers. Even the Rockefeller serum is shown to be quite unreliable at a dilution of 1 in 100. As has been mentioned elsewhere, we are hoping to investigate the method of absorption of agglutinations, on which Elser and Huntoon report so favourably.

III.—Carriers.

The number of positive contacts or carriers encountered depends entirely on the strictness with which bacteriological differentiation is carried out, and is to that extent unsatisfactory, as our methods of differentiation are at present difficult and still almost in the experimental stage.

In my particular district the number of contacts per case was very small, averaging under four per case, so that the total number

of contacts examined has been small. This is due to the great majority of cases having occurred in billets.

From my district 155 contacts in all have been examined, 7 of whom have been positive, giving a percentage of 4·5. One of these was found early on in our work, and is probably doubtful, which would reduce the percentage still lower. Three positives had to do with one case (Yg.), one of them being a man billeted with him, and two others men who followed on in the billet three or four days after the patient had left. This would point to an intermediate carrier, or might merely be a coincidence. An intermediate carrier could, however, not be found.

A good many of the positive carriers dealt with have been men from the Norwich area, sent to us by Dr. Claridge, who had found them repeatedly positive. We have also had some patients whose throats contained the meningococcus when they were in the convalescent stage. When the main epidemic was declining the staff of Ward 19 was examined, and among eleven nurses and seven orderlies all were negative except one. This positive was the ward-master, who had only been in the ward ten days. I was then inclined to suppose that it was possible that a positive phase had also been passed through by some of the other members of the staff, who had all been in the ward for a month or more. But quite recently a swab from the throat of this ward-master (Corporal W.) has again turned out positive, so it is more likely, as he has so constantly yielded cultures for months, that he is a more efficient carrier than the others, and that his case affords no evidence that a transient phase is frequently passed through.

I do not, however, think that the probability of a transient positive phase is at all unlikely; if true, it would assist considerably in elucidating the extremely scattered incidence of the disease, the intermediate carriers being practically impossible to trace. For instance, this may well have happened in the case of the three contacts of Yg. Other evidence of value in support of this is the fact that some of the contacts found positive on first swabbing have been found to be negative by the time (about a week) that the examination of the swab has been completed and they have come into the hospital.

As my experience is so small, answers to most of the headings in Section III would be valueless. I may only remark that our experience of nasopharyngeal catarrh in carriers is entirely negative. I have, on the contrary, been struck by the absolutely normal condition of all throats in which the meningococcus has been found.

Plenty of throats[1] have been examined in which signs of catarrh have been seen, but have all proved negative. The same remark applies to that peculiar spotted condition of the throat which has been looked upon with suspicion by some. The inference is very tempting, that a confusion has arisen between the *Meningococcus* and *Micrococcus catarrhalis* in respect to catarrh of the throat.

Another point that is more and more evident on examining the posterior pharynx of a large number of people is the variability in appearance and colour under normal conditions. I hesitate more and more to call a merely red throat an inflamed throat.

The length of time carriers may carry the meningococcus is very variable and often is prolonged. In the case of one of the cerebrospinal fever convalescents (Tm.), positive swabs were obtained for over a month, notwithstanding treatment. We have now still in hospital one of Dr. Claridge's contacts who has been positive to our knowledge for two months. This man is suffering from chronic ear trouble, and it is possible that the Eustachian tube forms a nidus for the organism. Tm. had greatly enlarged tonsils and also adenoids, and these may have been the cause of his persistent carrying of the organism. His tonsils and adenoids were removed and it was thought in subsequent examinations that he was free. An organism, however, which was obtained shortly after the removal and was at first considered to belong to the *flavus* group, on further study has been found to be suspiciously like the meningococcus.

My present opinion on this question is as follows: There is usually a reason for the continued persistence of the organism in the throat, i.e., either connected with enlarged tonsils or adenoids, or with an abnormal condition in one of the many cavities which are connected with the posterior pharynx and nose.

The evidence tends to the view that a person with a normal throat is only a transient carrier of the meningococcus.

As regards treatment, my experience is again small. The method found most satisfactory is nasal douching three times daily with permanganate solution. The solution is poured with a nasal douche right to the back of the nose and returns in considerable quantity through the mouth as well as the nose, thus thoroughly drenching the posterior pharynx. This method un-

[1] These include those who have been in contact with a definite case of cerebrospinal fever, and some who have been examined as "contacts," but who later were found not to have been in contact with a definite case of the disease.

doubtedly temporarily removes the organism from the posterior wall of the pharynx. Sprays and gargles have been found practically useless, the posterior pharynx hardly being touched by them.

Before a case under treatment by douching is examined by swabbing, two days are allowed to elapse so as to allow the organism again to appear if concealed in some accessory sinus.

IV.—Cases of Cerebrospinal Fever.

(1) *Incubation Period.*—The information concerning this which I have been able to collect is extremely vague, and mainly depends on indirect evidence, such as the occurrence of a case in a place previously free in a man who had recently been on leave. The question of the influence of leave on spreading the disease is discussed in Section I (*b*), and for the purpose of discussing the incubation period Table I may again be consulted, in which the period of leave is noted in the last column but one.

In five cases the disease developed within two days of the man's return from leave, the period between the commencement of leave and the onset of disease being three days, four days, five days (twice) and six days respectively. Three of these cases were the first cases of the disease noted among soldiers in the locality, one being at Bishop's Stortford, one at Houghton Regis, and one at Watford. If it is allowed, therefore, that these cases became infected while on leave, the incubation period appears to be a short one. The second case at Houghton Regis also occurred within seven days of the man's arrival at that place, and can almost be grouped with the other five, though a maximum limit is not here to be obtained. The same applies to the case from Saffron Walden. From the first five cases the incubation period would appear to be between three and six days.

The cases which occurred in men actually on leave give less direct evidence, and can be taken in two ways. Three of the men had been home between three and four days when attacked, and one fourteen days. This latter case occurred in a man on leave whose sister was extremely ill, and it is just conceivable that the sister was suffering from cerebrospinal fever and infected the man. I have, however, no information on this point. The matter is so uncertain as to be of no value for the present discussion.

In the case of the other three, however, two occurred within eight days of one another at Littleport in men on leave from different stations, Felixstowe and Bury St. Edmunds. There is

thus here presumptive evidence that the disease was contracted by both after arrival at Littleport, which would again bring down the incubation period to three days or less. As, however, I have no information concerning the occurrence of cases at Bury St. Edmunds and Felixstowe, the argument is not a strong one. The three remaining cases in which return from leave occurred within fourteen days of the onset of disease occurred at Bedford and Peterborough, both places in which some other cases had occurred; they are therefore devoid of value for the present argument.

To sum up, the little evidence available points to a comparatively short incubation period, lying between three and seven days.

Another point may be discussed here: Can a carrier carry the disease in his throat for some time and then under suitable conditions develop the disease? Of this all the evidence I have is in the negative. The number of carriers found in this district has been extremely few, so again my evidence is extremely scanty, but among the few carriers found no illness has ever developed, and catarrh of the throat has been conspicuously absent. Some carriers have been under observation for months, so there is ground for supposing that they are, similarly to diphtheria carriers, practically immune to the disease in the majority of cases.

(2) *Diagnosis.*—Clinically the differential diagnosis of cerebrospinal fever is a matter of considerable difficulty. Not only are the signs and symptoms extremely variable in undoubted cases of the disease, so that hardly any one is constant throughout, but also they are dependent on pathological conditions in the brain and spinal cord, which can be brought about by other infections of these organs beside that of the meningococcus.

In Table VII is given a list of cases, twenty-seven in all, which have been sent in to the First Eastern General Hospital as possible cases of cerebrospinal meningitis, and have ultimately been shown to be of a different nature.

A purulent infection of the brain and cord can be brought about by many organisms, and cases of such infection due to the pneumococcus, streptococcus and staphylococcus have all occurred in this list. The finding of a purulent exudate in spinal fluid removed by lumbar puncture is, therefore, not conclusive of cerebrospinal fever, using this term to designate meningococcus infections only.

Infections by the tubercle bacillus also can be very confusing, as in the later stages of cerebrospinal fever little or no pus may

be found in a puncture fluid, and the amount of fluid obtained may be very similar in the two conditions.

Two cases of this nature have occurred in the First Eastern General Hospital.

The general character of the cerebrospinal fluid obtained by lumbar puncture is therefore no reliable guide to diagnosis.

The matter is different if the bacteriology of the fluid is taken into account, and, as a rule, examination of films, and more especially culture of the fluid is reliable. The diagnosis is only certainly clinched by obtaining a pure culture of the organism, and by subjecting this to tests proving it to be the meningococcus.

In every acute case coming under observation this has ultimately been done, though in some the difficulties of obtaining a culture have been great.

In the majority of cases all the early punctures have grown freely, but in a few, notably those of Wr. and Js. in Table V, only one late puncture fluid has grown, while in the cases of H. and Ty., in Table VI, only the first puncture grew. In four cases the first puncture failed to yield a growth, while in one, that of Y., the third and fourth punctures were the only successful ones. In most cases, therefore, the diagnosis is settled by the successful culture of the organism from the first, and occasionally from the second, puncture.

The medium which has yielded the best results for this purpose has been blood agar, prepared from the fresh aseptically obtained blood of the rabbit. The various media sent out from the Royal Army Medical College, Grosvenor Road, have also usually succeeded, notably a mixture containing peaflour, which was found to be quite successful even without the addition of fresh sterile serum. Legumin agar subsequently supplied was found to be more uncertain and practically useless without the addition of fresh serum.

The routine method of cultivation adopted has been to sow the puncture fluid as soon as possible after it has been obtained on to three or four tubes, distributing the fluid generously over the surface with a loop. The puncture fluid has then been allowed to stand undisturbed from twelve to eighteen hours in the 37° C. incubator, so that any pus present sinks to the bottom. Fresh tubes have then been sown from the sedimented pus. This second sowing has been successful in a certain number of cases in which the first sowing has failed.

In all cases also films have been made both at once and after the incubation of the puncture fluid. Intracellular diplococci have been found in the great majority of cases in which pus has been

present, but often in extremely scanty numbers in the films of the fresh fluid. Their rarity has rendered the application of Gram stain difficult and rather unreliable, and methylene blue has been mainly used. The incubated fluid often shows diplococci in much greater numbers, though they are now no longer intracellular. They are, however, much easier to test by Gram stain.

In our experience the substantiation of Gram-negative diplococci in these films is quite reliable, and has been of very great use in those somewhat infrequent cases in which the earlier puncture fluids could not be grown.

Our routine method has therefore been to examine films, but to wait for the results of culture of the first, or if necessary the second puncture fluid, which have usually been obtained on the first two days, before definitely notifying a case as suffering from cerebrospinal fever. A pure culture of Gram-negative diplococci has then usually been obtained, which has put the case beyond doubt, for all such cultures have ultimately answered the test of the meningococcus. As has been mentioned in Section II, in one case, Tu., a Gram-negative diplococcus was obtained which did not ferment glucose; after some months of cultivation, however, it began to exhibit this power satisfactorily.

In the few cases in which the first two punctures have not grown reliance has been placed on the evidence of films; in these cases the films of incubated fluid have proved especially useful. The cases of Js. and Wr. are examples of the value of this method.

With the amelioration of the patient's condition, the puncture fluid became clearer and clearer, though often remaining at a high or even a higher pressure, and the fluids have ceased to grow or to show diplococci in film. In one case, therefore, which was obtained late in the disease, the puncture fluid proved entirely negative, and, on the whole, the earlier the case was punctured, the easier was the diagnosis. As puncture early in the disease is also of extreme value for the purposes of treatment, its advisability is obvious.

The facility with which most of our puncture fluids have grown is probably partly dependent on being able to sow them and deal with them in a laboratory almost immediately after they were obtained, owing to the collection of all cases into the First Eastern General Hospital as soon as possible.

Three cases only have proved doubtful in our series—the three which occurred in June; in none of these did films reveal any intracellular diplococci, and no cultures could be obtained. These

cases were all comparatively mild, though all gave clinically undoubted signs of meningitis. The course of the disease and the complete recovery which ensued, combined with the actual presence of polymorphonuclear cells in the puncture fluids, gave rise to the final conclusion that these were probably cases of a mild type. In my experience no other purulent affection of the meninges ever recovers. In one of the three (O.) an organism was obtained from the throat identical with the meningococcus.

To sum up: The combined method of examination of films and culture of the puncture fluid enables a diagnosis to be obtained in practically every case in from two to three days, the diagnosis in the majority being clear in one day. This bacteriological method of diagnosis is essential, and the only reliable one.

Cases of purulent meningitis due to other causes can also in the vast majority of cases be diagnosed by the same methods.

In other cases sent in as possible cerebrospinal fever the puncture fluid, when obtained, was always found to be perfectly clear and normal, though it may be noted that in a few of the cases, notably acute influenza and pneumonia, the spinal fluid was found to be under considerably increased pressure. It is possible that some of the cerebral manifestations in these diseases may be directly due to this increased pressure, as distinct relief of such symptoms as intense headache was obtained on its removal by lumbar puncture.

(3) *Specific Treatment.*—The most successful treatment in our hands can be stated shortly. It is immediate and daily lumbar puncture so long as there are no marked signs of clinical improvement. If the improvement commences, but is not maintained, lumbar puncture should again be resorted to.

Table V shows those cases which have recovered. The first seven cases all had illnesses lasting three weeks or under, the shortest period being eleven days in two cases. In all these lumbar puncture was performed daily so long as any clinical indication existed for it, except in the case of Wg., who appears to have been an exceptionally mild case, and was only punctured on the day of admission, the fifth day of his illness. In three out of the first four cases lumbar puncture was done within twenty-four hours of the onset of disease. It is also to be noted that no serum was given in any of these cases. The clinical effect of lumbar puncture is extremely striking, and the patients frequently become extremely desirous for it, as they obtain such relief. In the cases in which serum was injected after removal of the spinal fluid, this clinical relief was markedly absent.

TABLE V.

Recovered. Name	Number of punctures	Days of illness on which L.P.	Mulford serum given	Number growing	Days of illness on which they grew	Length of illness, days	Course of illness
Tm. ..	2	1, 2	..	2	1, 2	11	Uninterrupted recovery.
Rk. ..	**3**	1, 2, 3	..	3	1, 2, 3	11	,, ,,
H. ..	5	4, 5, 6, 7, 8	..	1	4	15	,, ,,
Ty. ..	7	1, 2, 3, 4, 5, 6, 10	..	1	1	15	,, ,,
Wg. ..	1	**5**	..	1	**5**	21	,, ,,
Wd. ..	11	5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 20	..	9	5, 7, 8, 9, 10, 11, 12, 13, 20	22	,, ,,
Yg. ..	10	5, 6, 7, 8, 9, 10, 11, 14, 17, 22	..	5	5, 6, 7, 8, 10	22	Practically uninterrupted recovery.
Wr. ..	6	**3**, 10, 12, 15, 17, 19	**3** (30 c.c.)	1	19	26	Fair recovery.
Tp. ..	6	4, 5, 6, 7, 8, 9	..	6	4, 5, 6, 7, 8, 9	27	Uninterrupted recovery.
Mr. ..	1	**3**	**3**	..	..	28	,, ,, (?)
Bo. ..	5	3, 4, 5, 6, 11	3 (5 c.c.), 4 (15 c.c.), 5 (10 c.c.), 6 (15 c.c).,11(5 c.c.)	2	3, 4	30	Fair recovery.
G. ..	0	..	..	..	..	32	Uninterrupted recovery.
Sw. ..	8	4, 5, 6, 7, 8, 9, 10, 12	..	7	4, 5, 6, 7, 8, 9, 10	36	Fair recovery.
N. ..	4	3, 4, 5, 9	..	3	3, 4, 9	38	,, ,,
St. ..	1	**7**	..	0	..	41	Moderate recovery (heart).
Ak. ..	12	5, 6, 8, 9, 11, 15, 16, 18, 26, 35, 36, 38	16 (10 c.c.), 18 (15 c.c.), 26 (15 c.c.)	6	6, 8, 11, 15, 16, 18	48	Gradual recovery.
R. ..	2	35, 49	..	1	35	56	,, ,,
Js. ..	17	8, 9, 11, 12, 14, 16, 18, 21, 22, 27, 35, 39, 41, 42, 44, 48, 51	..	1	21	62	Intermittent recovery.
M.* ..	2	43, 60	..	0	0	64	,, ,,
B. ..	2	11, 12	..	1	12	72	Intermittent and prolonged recovery.
Tu. ..	6	3, 9, 48, 67, 74, 77	77 (5 c.c.) of own serum	4	3, 9, 48, 67	86	,, ,, ,,
Rw. ..	32	5, 6, 7, 9, 10, 11, 13, 14, 15, 16, 23, 25, 27, 29, 31, 32, 33, 34, 36, 37, 38, 40, 41, 42, 43, 46, 48, 50, 52, 56, 58, 60	..	22	5, 6, 7, 9, 10, 11, 13, 16, 27, 29, 31, 32, 33, 34, 36, 37, 38, 40, 41, 42, 43, 52	100	Intermittent recovery.
Jh.* ..	12	8, 9, 10, 11, 16, 18, 19, 22, 24, 31, 37, 43	..	6	9, 10, 11, 31, 37, 43	102	Intermittent and prolonged recovery.

* M. and Jh. were readmitted.

Note.—Lumbar punctures performed outside the First General Eastern Hospital by others indicated by black figures.

In the case of Bo., in whom serum was regularly used, the length of the illness does not compare favourably with the cases just quoted.

Another group of cases which recovered lasted from twenty-six to thirty-two days. In three of these, Wr., Mr., and G., as is seen in Table II, admission to the First Eastern General Hospital did not take place till late. In two of them, lumbar puncture had been done elsewhere and serum had been given; in one no serum had been given and no puncture apparently performed; the duration of the illness in this case was thirty-two days. This may perhaps be taken as an indication of the course of recovery of an untreated case.

It may be here remarked that the termination of the illness has been taken throughout to be that day in which all signs and symptoms, such as Kernig's sign and headache, have permanently disappeared, and the temperature has finally come down to normal.

A fourth case in this group is that of Bo., already referred to.

In a third group of cases recovery was gradual but more or less uninterrupted, lasting from thirty-six to fifty-six days. Two of these were obtained only late in their illness, namely St. and R., and in two others lumbar puncture was commenced rather late, namely in the case of Sw. and Ak., and in the remaining case (N.) might well have been continued daily for a longer period than three days.

Finally, a fourth group ran a very prolonged and intermittent course. One of these, again (M.), was only admitted one month after the first onset; one (Tu.), was not punctured daily in the early stage of his illness. In one (Rw.), the first puncture only took place on the fifth day. In two (Js.) and (Jh.), it only took place on the eighth day, and in one (B.) it took place on the eleventh day and was not continued.

In this table the cases in which serum was used do not compare favourably with the rest.

The case of Tu. may be further mentioned. An extremely chronic condition of intermittent headache and other symptoms suddenly came to an end on the administration of 5 c.c. of his own serum. This may have been merely a coincidence, but it was tried as the result of agglutination experiments with the patient's own serum and serum kindly supplied me by Dr. Flexner from New York. The patient's own serum was found to be more highly agglutinating than the Flexner serum, and was therefore tried. This particular case may point to serum, preferably from the patient himself, as being of value in chronic cases.

TABLE VI.—FATAL CASES.

Died. Name	Number of punctures	Days of illness on which L.P.	Mulford serum given	Pus	Number growing	Days of illness on which they grew	Length of illness	Course of illness
Bd. ..	1	2	..	Pus V ..	1	2	36 hours	Fulminant.
Hs. ..	1	1	1 (20 c.c.)	,, V ..	1	1	36 ,,	,,
As. ..	1	3	..	,, V ..	1	3	4 days	Unresponsive.
C. ..	2	3, 4	3, 4 (15 c.c.)	,, V ..	2	3, 4	4 ,,	,,
J. ..	3	3, 4, 5	..	,, V ..	3	3, 4, 5	5 ,,	,,
Dn. ..	3	2, 3, 4	..	,, V ..	3	2, 3, 4	5 ,,	,,
F. ..	2	3, 4	..	,, V ..	2	3, 4	5 ,,	,,
Ht. ..	2	4, 5	..	,, V ..	2	4, 5	5 ,,	,,
My. ..	4	2, 3, 4, 5	3, 4, 5 (15 c.c.)	,, B ..	4	2, 3, 4, 5	5 ,,	,,
Mt. ..	0	0	..	,, V ..	0	0	15 ,,	,,
Ss. ..	9	4, 5, 6, 7, 8, 9, 11, 13, 14	7 (15 c.c.), 14 (6 c.c.)	,, + + + +	9	4, 5, 6, 7, 8, 9, 11, 13, 14	19 ,,	Some response.
An. ..	15	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18	..	,, + + +	15	3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18	23 ,,	Responded fairly.
A. ..	14	4, 21, 22, 23, 24, 25, 26, 28, 30, 33, 35, 44, 46, 47	..	,, + H	11	4, 21, 22, 23, 24, 25, 26, 28, 30, 33, 34	49 ,,	Responded well; relapse 20th day.
D. ..	30	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 23, 26, 28, 31, 32, 34, 35, 36, 37, 38, 39, 42, 44, 49	Subcut.: 14, 15, 18 (30 c.c.), 21, 22 (25 c.c.) (B. W. and Co.)	,, — ve. H	16	5, 6, 7, 8, 9, 10, 15, 16, 26, 28, 32, 34, 35, 36, 37, 39	51 ,,	Irregular; slight temporary response; complete occlusion of subarachnoid space in dorsal region
Y. ..	15	6, 9, 11, 13, 40, 43, 44, 46, 47, 48, 49, 50, 51, 54, 56	..	,, — ve. H	2	11, 13	63 ,,	Response very slight.

H = hydrocephalus of third and fourth ventricles.
V = vertex.
B = base.

Turning now to Table VI of cases which died, the first group consists of nine, in which treatment seemed to have no influence at all. Two were fulminant in character, while the other seven all ran a course of four or five days. It may, perhaps, be remarked that none of these seven were punctured on the first day of illness and only two on the second day. It is perhaps unlikely that earlier puncture would have influenced them; as none of them responded at all when they were punctured, it is more probable that the disease here was so severe that no treatment could have influenced it. The post-mortem findings are here of interest. In the greater number the pathological condition was vertical to a marked degree, a most intense congestion of the whole of the meninges being accompanied by a wide distribution of pus scattered all over the vertex in patches. It is difficult to believe that such a severe comprehensive cranial affection could be influenced by any treatment. The next case (Mt.), lasting fifteen days, remained undiagnosed till the post-mortem examination and was never punctured.

TABLE VII.

Disease	Number	Deaths	Suspected C.S.M. cases. *Negative*
Pneumonia	5	1	Dp., Capt. Hn., Pr., *Ps.*, Rs.
Influenza	6	0	E., Ep., Hy., Pe, Rv., Wa.
Tubercular meningitis	2	2	*Dt.*, *Pt.*
Pneumococcal meningitis	1	1	*Ry.*
Streptococcal meningitis	1	1	*Ms.*
Staphylococcal meningitis	1	1	*L.*
Subdural abscess	1	1	*J. R. J.*
Acute myelitis	1	0	Hg.
Cerebral embolism	1	0	Bt.
Cerebral tuberculosis	1	0	Nh.
Cerebral hæmorrhage	1	0	Py.
Delirium tremens	1	0	V.
Convulsive hysteria	1	0	Bw.
Neuromimesis	1	0	Ay.
Insanity	1	0	Ms. (Reported by Netley as C.S.M.)
Tonsillitis	1	0	Sw.
Pharyngitis	1	0	Cu.

27 in all, with 7 deaths: { 5 meningitis, 1 subdural abscess, 1 pneumonia } These cases are in italics.

The cases of Ss. and An. are interesting. The pus in the spinal fluid, thick to start with, became increasingly difficult to draw off, till finally, in the case of Ss., only a thin serum could be obtained. Post-mortem, however, it was found that a dense glutinous pus completely filled the thecal space throughout the cord and coated over completely the base of the brain. Here again it is difficult to see what treatment could have been adopted to cause a thinning of this pus.

The last three cases (A., D. and Y.) all showed post mortem a condition of marked dilatation of the central ventricles of the brain, and died with symptoms of excessive pressure on the fourth ventricle.

A. suffered a true relapse, going on well for the first eighteen days of his illness, and then getting all signs and symptoms back in a severe degree, the spinal fluid again being found to be purulent and showing the meningococci freely.

It is possible that more persistent lumbar puncture in the first instance might have averted the relapse.

In the case of D. subcutaneous injections of serum were tried, but were entirely without visible or ultimate effect. Here, again, earlier lumbar puncture might have cut short the illness, the first puncture only taking place on the fourth day. The immediate cause of death was complete occlusion of the subarachnoid space by scarring, so that the later punctures were useless to relieve the hydrocephalus.

Y. was first punctured on the sixth day and next on the ninth, and then subsequently very intermittently till late in his disease. The late punctures all gave a clear fluid at high pressure. He was finally left seven days without puncture, and at the post-mortem a very large amount of fluid at high pressure was found in his third and fourth ventricles.

The pathology of this ventricular dilatation, which markedly affects the central rather than the lateral ventricles, is probably after-scarring in the membranes following on the primary acute infection, and the *rationale* of lumbar puncture is here the prevention of too high a pressure of approximately normal cerebrospinal fluid, in contra-distinction to the reason for puncture in the early stages, which may be compared with draining an abscess. The failure of the first puncture to give a growth in some cases points to the similarity of the condition to that in an abscess—it is only when a flow is established into the cavity that live organisms can be withdrawn.

The evidence obtained is therefore all in favour of early and frequent lumbar puncture, and throws grave doubts on any additional value of antimeningitis serum.

It is perhaps possible to interpret the more favourable results following the introduction of the serum as being really due to increased lumbar puncture, which had to be performed in order to introduce the serum.

COLOUR-BAR: A DIGRESSION IN ETHNOLOGY.

By Colonel R. H. FIRTH.

It will be conceded that, all over the world, the law of custom is slowly breaking down. The influence of steamships and railways is steadily removing the isolation of many races, and alien settlers are intermarrying with many old-time peoples. So great and so cosmopolitan are the forces now at work, that the ethnologist of the future will probably have no pure races left to examine. In fact, it is safe to say that even now no one of the existing peoples is racially pure; we are tempted to go so far as to say that there never has been a pure race since the Mousterian Age; certainly there has been none in Europe during historical times.

We may put the present population of the world at some 1,500 millions, and these we may classify as being 700 millions who are progressive and 800 millions who are stagnant under the law of custom. We cannot say civilized and uncivilized owing to the existence of the London "hooligan," the Parisian "apache" and the New York "Bowery tough." Even the terms progressive and stagnant are inadequate, as witness the Parsi gentleman and the Somerset farm labourer. In the same way, white and coloured are no more satisfactory, for there are Afghans and Chinese many shades whiter than the Portuguese. The problem that will have to be solved by the next generation, and as to which this article aims at directing thought, is, What part is to be taken in the world's affairs by the 800 millions of so-called stagnant or uncivilized men who happen to be pigmentally different to the other 700 millions? The answer is intimately associated with that to another question, Is there any inherent inferiority in their equipment of mind and character? Readers of our daily press will appreciate the presence of this question at our very doors to-day.

The law of custom was the only law known to our forefathers, until the infusion of new blood and new customs forced them to choose between the old and the new, and to make new laws to meet new needs. All this happened so long ago that, if it were not for a few ceremonial survivals, we might well doubt whether our forefathers were ever stagnant. Isolated races will remain stationary for centuries under an ethical code which bids them do as their fathers did before them. In nearly all these cases, custom

is interwoven closely with religion, and is enforced by a fear of punishment in this life. Among patriarchal races, whose gods are their ancestors, this view is strongest, for to depart from the ancestral custom is to insult the tribal god, and it is therefore the business of every member of the tribe to see to it that he suffers no personal harm through the impiety of one of his fellow-tribesmen; so custom holds everyone in its iron hands from the cradle to the grave, and a man cannot move hand or foot without the dread of breaking some *tabu*. It is true, the law of custom has been swept away by conquering races many times in the world's history, but in all these cases, where new customs took root at all, they were implanted by force upon the weaker race by the strong hand of its conquerors, and, as the subject race had obeyed its own custom-law through fear of the unseen, so it adopted the new law through the fear of its new masters. It was a rough but wholesome schooling. Nowadays we go to work in another way; there is little of the conqueror's way about us; we saunter into a country and trade with its inhabitants; we undermine their customs without forcing them to adopt ours; we teach the precepts of Christianity, and in the same breath assure them that, instead of physical punishment by disease which they used to fear when they did wrong, their delinquencies will be visited by eternal punishment after death, a remote contingency which presents no terrors to them; and when the novelty of the idea has worn off they are left, like a rudderless ship, to drift where the wind of fancy drives them. From this point of view, in the coercion of native races the *suaviter in modo* is a more dangerous process than the *fortiter in re*. The fabric of their social system has been built up gradually; we may raze it to its foundations and erect another building in its place, but if we pull out a stone here and there the whole building comes tumbling about our ears before we have time to do any rebuilding.

To some a comforting belief is, that Nature will maintain a balance by operation of a natural law that primitive races begin to decline in numbers as soon as Europeans come into contact with them. A few cases of the kind are on record, but only in respect of islanders, among whom a new disease on introduction has run riot. But we know now that this phenomenon is but temporary and is far from general application. Some continental races have never shown a tendency to decrease, in spite of close contact with Europeans: they seem immune from the ordinary epidemics that have proved so fatal to insular natives. Their capacity for numerical increase would seem to be limited only by the capacity

of their country to support them. Of course, we cannot ignore the fact that as uncivilized people begin to adopt scientific methods of medicine and surgery they will begin to elude the law of the survival of the fittest, but, on the other hand, the more isolated races, who are now the victims of new diseases, will gradually become immune. It is probably safe to predict that the rate of increase of the more virile races will decline as the change in their habits begins to affect them. The European is reckoned to double his numbers in eighty years, the Chinese in sixty, and the African negro in forty years. If this statement be only half true, the outlook for men of European descent is not bright; but, making all allowances, it is obvious that the over-population of the earth is within sight unless some unforeseen agency intervene to prevent it.

We have already premised that no existing people is racially pure, but in spite of this we find nationality and patriotism much in evidence. Possibly both are artificial and really geographical sentiments, yet the whole path of human advance through the centuries is strewn with the corpses of race hatred. Now, the real test by which to gauge race hatred is the test of intermarriage. If two races live side by side for a century or two without any intermarriage, one may conclude that the colour-bar is natural and not an artificial sentiment. Historically, we have little to guide us. Virgil in his eighth Æneid (687 to 688) unhesitatingly condemns the marriage of Antony with Cleopatra, and Horace in his first Ode (37), referring to the relations of Julius Cæsar with the same lady, calls her a "fatale monstrum." Similarly Titus was obliged by public opinion to part with Queen Berenice. In all these cases, and also in the case of Roman soldiers taken prisoner by the Parthians and then marrying native wives, the condemnation was due rather to pride in Roman citizenship and to contempt for barbarians rather than to any colour-bar. Though Juvenal, in his second Satire (23), classes the Ethiopian skin as a physical defect in the same category as bandy legs, one fails to find evidence from the Romans of any colour antipathy having been a bar to intermarriage. This is a very interesting question to us, and much turns upon the question whether race antipathy is inherent, for when two races are brought into contact and competition there is no middle course. Either race antipathy must disappear, or one breed of man must dominate and extinguish the other. Few people have studied race hatred dispassionately, and it calls for calm, cold scrutiny in these times. We meet with it in its acutest form in the United States. In England it is weak and confined

exclusively to those who have lived in the Tropics. In other European countries it is scarcely noticeable. If we look back a bit, we find that race antipathy is a sentiment of modern growth. In the fifteenth and sixteenth centuries, Englishmen do not seem to have thought coloured people their inferiors by reason of their colour. The only race hatred in the Middle Ages was anti-semitic, and this was probably due to the Crusades. Shakespeare saw nothing repulsive in the marriage of Desdemona with a man of colour. The colour-bar seems to have dated only from the slavery period in the West Indies with us, and yet the Romans, Spaniards, Portuguese and Dutch, who were great slave-owners, do not seem to have felt it. These considerations give cause for thought, and, though we do not see clearly the racial future of mankind, certain facts are clear, and one of these is, that a white skin cannot for ever be a kind of patent of nobility. Race prejudice does not die so hard as many think, and when the white man finds himself in a state of political or economic inferiority, he is and will be ready to drop his racial pride and adapt himself to circumstances. It is an unpalatable truth, but a truth all the same.

The real question for the moment is, How far are the backward races fit to compete with Europeans? Someone has said that the average man is incapable of assimilating much more knowledge than his immediate ancestors could acquire, and that the growth of the mind can, in the average man, be but by fractional increments in each generation. There are more exceptions than will prove any such rule. One has only to realize that Brooker Washington and Bughardt Dubois were both full-blooded negroes, or even to look around one in this country or in India. In some physical attributes, such as the sense of smell, the average European falls far below the Malay or Japanese, and a little below the Murray Islander, who excels him in the sense of delicacy of touch and in nice discrimination between small differences of weight. Mental attributes are not open to any scientific test. In making comparisons between the mentality of two races, one must compare the average with the average, and not the average of one race with the exceptional individuals of the other. At most we can say that, so far, there is no evidence to show that any of the backward races have produced individuals equal to Europeans of the first calibre; but we are bound to admit that, among a limited number of individuals of those races, one finds the same aptitude as among the average of Europeans, and that there is, so far as is known, no race of marked mental inferiority, though there may be a larger number of slow

witted individuals in one race than in another. What is lacking, as a rule, in the backward races is character and application. It is strength of character, rather than intellectual power, that achieves big things in this world, and of character we may say it is probably affected by climate and by pressure of circumstances. We must not be rash to assume that character and application are lacking in all individuals of the backward races. Far from it, there are many instances on record. True they are rare, but they are becoming less rare; all around us we see men who are defying the law of custom to their material profit, though not always to their peace of mind perhaps.

As a student of heredity, one can find nothing to encourage the belief that the white and the coloured races will coalesce to produce an intermediate type, but it is a popular error to believe that intermarriage on a large scale would be physically disastrous. The half-caste offspring of such mixed marriages is supposed to inherit the vices of both races and none of the virtues. This is not true, and the idea is based on superficial knowledge of facts and superficial thinking. What little truth there be in the accusation, the social ostracism in which these people are condemned to live would be sufficient, and is sufficient, to account for it. Disowned by their fathers and unrestrained by the customs of their mothers' people, it could scarcely be otherwise. But those who know the Eurasians of India and the half-castes of many races all agree that in aptitude they are equal to the average European, when they have the same education and opportunity. There is, moreover, no physical deterioration in the offspring of half-castes *inter se*. In Java, where the Dutch regard them as social equals, they are eligible for the highest positions in the colony.

Looking at the question from the impartial and critical standpoint, one is forced to conclude that the day is not far distant when, in tropical countries, the line of colour will cease to be the line of social caste. There, as elsewhere, wealth will create a new aristocracy recruited from men of every shade of colour. In this country, in India, and in China the process may be accelerated, for labour unrest and high wages in western lands may compel manufacturers to transfer capital to countries where labour is cheap, plentiful and efficient. The writer of this article knows many men of Hindu and Chinese and Arab origin in London, Manchester, and Liverpool, who control large industries with their wealth. These are no isolated cases, but indices of the time. The day is not far distant when the aristocracy of wealth and of brains will be

composed of every shade of colour. So, too, will be the masses of the workers. In one country the majority of workers will be black or brown, in another, white; but throughout the white man will work shoulder to shoulder with the black and feel no degradation. Logically, why should he, and by stress of evolutionary environment what alternative will he have? It is the picture of no visionary to say that in the near days to come there will be the same feverish pursuit of wealth, the same struggle between capital and labour, but all races will participate in this distribution of wealth. The world, possibly, will then be neither so pleasant nor picturesque to live in as now, but the dominant note will be the curious absence of colour-bar and the evident decay of the law of custom. Few of us are free from prejudices on this colour question, but no thinking man can conceal from himself the need for a saner outlook. To stimulate thought in that direction this article is written, and merits calm reflection by those of us in the Service called to serve in lands other than our own, and often alongside of men racially and pigmentally different from ourselves. Every man is entitled to his own opinion, but let us not be blind to the wider outlook, and be ever mindful that every shield has two sides. Times are changing, and it is for us all to be not only alive to those changes, but also in touch with all arguments and influences which are bringing about these mutations. One writes in no spirit of dogmatism, but rather as the detached observer who sees things too often overlooked by those in the thick of the fight, also as one anxious to warn others of possible troubles ahead, and impressed with the need for an intellectual anticipation of the same.

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THE SURGICAL TREATMENT OF WOUNDS ON A BACTERIOLOGICAL BASIS.

By Captain J. O. HAMILTON.
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The bacteriological aspect of this war is one of great importance and interest. Many of our most eminent bacteriologists are studying daily the bacteriology of the wounds under treatment in our hospitals. Many reports have been given and are being prepared, and my apology for bringing before your notice this report is, that by considering all results some definite conclusion will be arrived at. During the last five months I have been stationed at base hospitals in France, and have had an opportunity of treating and investigating the bacterial infection of wounds admitted either directly from the firing line or from our advanced clearing hospitals. The wounds received by us have practically all been infected or septic, and I think all should be regarded as such. The average number of days from the date of the wound being received until it was examined at the base was three days. The number of cases examined bacteriologically was forty-five.

The type of wound selected for examination varied, e.g., superficial — compound fractures of femur and humerus — and deep penetrating flesh wounds. The wounds usually showed an œdema extending some distance from their edges, and in the more severe cases this extended to a very considerable distance above and below the wound.

The bacterial infection of the wounds investigated was invariably a multiple one. The more severe the infection and general toxæmia, the larger the number of organisms isolated. The bacteria fall into two groups:—

(1) Those generally pathogenic for man, e.g., pyogenic cocci and *Bacillus coli*.

(2) Those only very exceptionally pathogenic, e.g., *B. aërogenes capsulatus* and *B. proteus*.

On the average three organisms have been isolated from the forty-five cases investigated. In severe cases, seen early, as many as five have been isolated. This has been observed to occur in cases in which treatment has been delayed or inadequate and in those giving the clinical picture of gas gangrene.

The commonest infecting organism is the *B. aërogenes capsulatus*. It was found in thirty-one of the cases out of the forty-five. The readiness with which it grows varies directly with the amount of necrotic tissue in the lesion. It is thus easily cultivated from untreated wounds or in those which have not been dressed early or frequently. In cases which could be freely exposed to the air *B. aërogenes capsulatus* soon disappeared.

Staphylococci were found as frequently as *B. aërogenes capsulatus*, the white staphylococcus being by far the commoner variety. It was found thirty times in the forty-five cases, the type being that generally known as *Staphylococcus pyogenes albus*. It is a rapid gelatine liquefier and sugar fermenter. It persists in wounds for a considerable time and is often found in pus of chronic suppuration after gunshot wounds, it being the only organism capable of cultivation in some cases. The *S. epidermidis* was also frequently identified, but I have classified both in the table under the heading of "*albus*."

S. pyogenes aureus was found fifteen times in the forty-five cases and conforms in type and reactions to the usual variety. Cases infected by this organism were always severe. In this connection it is of importance to note that in many of the cases in which this organism was found, acute inflammation of the bone developed, tending to spread rapidly, amputation having to be performed.

Streptococci appear as two separate types—an aerobic and an anaerobic; the majority are of the latter type and seem to flourish in the conditions favoured by the *B. aërogenes capsulatus*. In some cases the infection narrows itself down to a purely streptococcal one, and may then become a chronic discharging wound.

Many cases on culture, or even in films of fresh pus, proved to be infected by a Gram-negative bacillus. Twenty-four cases showed an infection of this type. The organism varied considerably: whereas in ten the growth and reactions were typical of *B. coli communis*, in fourteen the growth was very abundant, and so-called "amœboid," spreading rapidly over the surface of the medium and overgrowing every other organism. Sir Almroth Wright gave me the clue that I was dealing with a bacillus of the *proteus* group, and this has proved correct. Considering the habitat of *B. proteus* in soil, its occurrence in these cases is of great interest, but in only one case, a bullet wound of the vertebral column causing further paralegia and death from meningitis, could it be accused of being the causative organism.

Case	*Staphylococcus albus*	*Staphylococcus aureus*	Streptococcus		*Bacillus aërogenes capsulatus*	*Bacillus coli*	*Bacillus proteus*
			aerobic	anaerobic			
1	+	..	+	..	+	..	..
2	+	..	+	..	..	+	..
3	+	..	+	..	+	+	..
4	+	..	+	+	+	+	..
5	..	+	..	+	+	..	..
6	+	..	..	..	..	..	..
7	+	..	+	..	+	..	+
8	..	..	+	..	+	+	..
9	+	..	..	..	+	..	..
10	+	+	..	..	+	+	..
11	..	+	..	+	+	..	+
12	..	..	..	+	+	..	..
13	+	..	..	..	..	+	..
14	+	..	..	+	+	..	+
15	..	+	+	..	..	..	..
16	+	..	..	+	+	..	..
17	+	..	..	+	+	..	..
18	..	+	..	+	+	..	+
19	+	..	..	..	..	..	..
20	+	..	..	+	..	..	+
21	..	+	..	..	+	..	..
22	..	..	..	..	..	..	+
23	..	+	..	..	+	..	..
24	+	..	..	..	+	+	..
25	+	..	..	..	+	..	..
26	+	+	..	..	..	..	..
27	..	+	+	..	+	..	+
28	+	..	..	..	+	..	+
29	+	..	..	..	+	..	..
30	+	..	..	..	..	..	+
31	+	..	..	..	+	+	..
32	+	..	..	+	+	..	..
33	+	..	..	+	+	..	+
34	+	..	..	..	..	..	+
35	..	+	+	..	+	..	..
36	+	+	..	..	+	..	+
37	+	..	..	..	..	+	..
38	..	+	..	+	+	..	..
39	+	+	..	+	+	..	..
40	+	+	+	+	+	..	..
41	..	..	..	..	..	+	..
42	..	..	+	..	..	..	+
43	+	..	..	+	+	..	..
44	+	..	+	..	..	..	+
45	..	+	..	+	+	..	..
Cases 45	30	15	12	16	31	10	14
						24	

Another organism identified was a diphtheroid bacillus, which often occurred in large numbers but quickly disappeared from the infection. *B. tetanus* was only once identified, the patient succumbing to the infection. *B. pyogenes* was also twice identified and cultivated in pure growth. From the majority of wounds also, all forms of pathogenic fungi, phycomycetes and mycomycetes were identified, and it was noticed that those wounds which gave the most luxuriant growth of these were fungi by far the most foul in odour.

The treatment of gunshot wounds, which may be regarded as being all septic, must be considered from a bacteriological aspect to get the best results. On examining the table of bacteria identified in the wounds, one is at once struck by the constant occurrence of certain bacteria, and of being able to divide them into two large groups of aerobic and anaerobic bacteria.

The bacteria which belong to the aerobic group, e.g., pyogenic cocci and *B. coli*, are the cause of the majority of septic wounds which one has to deal with in civil practice, but those which fall into the anaerobic group are seldom met with. This group includes the organisms of tetanus and those which produce the severe condition of gas gangrene.

There are numerous gas-producing organisms, but the one most frequently found has been *B. aërogenes capsulatus* of Welch, or *B. perfringens*, as it is named in France. *B. œdematis maligni* is also another allied species. This organism is a spore-bearer, but it is known that other anaerobic bacteria, such as the *B. aërogenes capsulatus*, which do not usually form spores, may do so under conditions unfavourable to them in their bacillary form.

These organisms in their spore or bacillary form are found in soils and dust, especially if these have been contaminated with the excreta of herbivorous animals. It is thus easily conceived how the wounds which have been received after a prolonged trench warfare are contaminated with these anaerobic organisms. The skin and clothes become contaminated with all sorts of pathogenic organisms or their spores, the foreign body carrying them to the farthest point of the wound.

Another way in which a wound may become infected is by the the bursting of a percussion shell in the ground, the small pieces carrying the earth with contained organisms into a wound, which they may inflict. To have, then, infection of a wound contaminated with soil containing anaerobic bacilli or their spores there must be conditions favourable for anaerobic growth.

In considering the class of wound one has to deal with, one

cannot fail to recognize that the above condition is present in a very short time after the wound is received, if not at once.

Generally, the wounds are of the class known as "lacerated," indicating a tearing of the tissues. On examining the wounds after free incision, one is often surprised at the amount of damage to the tissues that has been inflicted by a comparatively small foreign body. Many small pockets are found which pierce far into the surrounding muscular and other tissues. Soon the mouths of these pockets are closed by coagulation of blood and serum, forming an ideal habitat for the anaerobic spore settling there. The spore having been established in an anaerobic condition, develops into its bacillary form. Toxins are soon formed which have a rapid necrosing action, and so a further advance of the anaerobic conditions. The bacilli then advance into the necrosed and anaerobic tissue, fresh tissues surrounding are successively necrosed by the formed toxins, and so a steady advance of the infection proceeds. It has not been definitely decided whether the advancing necrosis is due to the action of the toxins formed by the bacilli or to the action of the by-products formed in the process of the previous tissue necrosis. Sulphuretted hydrogen is one of the gases formed as a by-product, which has a specific action on the red blood corpuscles by combining with the iron of the hæmoglobin.

The common aerobic bacteria will also be present, but the danger from them is of much less moment than the anaerobes. The lacerated condition of the wound also favours their growth, as the tissues are in a state of depressed vitality.

Many of the aerobic organisms of suppuration have a wide distribution in nature, many are present in the skin and mucous membranes of healthy individuals, whilst the *B. coli communis* is a normal habitant of the intestinal tract. It is interesting to note that the *B. coli communis* cultivated from various lesions is more virulent than that in the intestine, the growth in the tissues having increased its virulence.

Treatment.

In treating these wounds, the primary object is to get rid of these organisms by removing the conditions favourable for their growth; and secondly, to counteract the already absorbed toxins.

(1) *Asepsis.*—All wounds, although they are infected and septic, should be treated aseptically. By that I mean that surgeons, sisters, and orderlies should be as particular as if they were performing an abdominal operation. All instruments should be

sterile and at once sterilized after each case is dressed. No dressing should be applied unless sterile. The area round the wound for a considerable distance above and below should be well washed with spirit soap or ordinary soap and water followed by methylated spirit, and then thoroughly painted with tincture of iodine.

Some surgeons hold the view that much washing and treatment of the surrounding area tends to favour the advance of the sepsis, but I believe that the thorough disinfection of the skin altogether outbalances that view.

(2) *Free Incisions.*—The sooner and the more freely incisions are made, the better is the bacteriological result. The more severe cases are always those which have not a free drainage, either on account of the position of the wound or as a result of the opening becoming closed by a blood-clot, &c. It has also been noted that bad results usually follow where stitches or plugs have been used. The introduction of sutures, even in the largest of wounds, should be absolutely avoided, the introduction of large drainage-tubes being the only treatment admissible. Sir Almroth Wright has previously pointed out the marked bacterial change for the better immediately free drainage is established.

(3) *Antiseptics.*—Antiseptics, to be effective, must be of the most powerful nature. Even then they will only act on the superficial bacteria in the wound and prevent the dressings from forming a suitable nidus for the growth of bacteria in contact with wound. On the other hand, strong antiseptics, e.g., carbolic, cause a coagulation of lymph, leading to the formation of a firm scab, thus closing the wound pockets, and so favouring anaerobic growth.

The treatment of wounds by the method of constant irrigation I have found to give the best results. The antiseptic solution used should be weak, or only saline solution. The continuous application of a weak antiseptic washes away the septic material as soon as it is formed, and also prevents coagulation. In employing constant irrigation, precautions must be taken against wetting of the patient by using suitable macintoshes, or tin vessels in the case of extremities. The nozzle of the tube should lie in the wound and the fluid should not drop from a height, as such dropping causes severe pain in a short time.

(4) *Oxygenation.*—By oxygenation, I mean the free exposure of the wound to oxygen. This can be accomplished by one of the following ways :—

(*a*) The application of *peroxide of hydrogen,* which gives up

its extra atom of oxygen on coming in contact with oxidizable matter. The best method to apply H_2O_2 to a superficial wound is by some form of spray. The fine vapour more easily gets to the recesses of the laceration and there is not so much waste as there is by applying it through a syringe or, which is the same thing, pouring it on from the bottle. I have used with signal success H_2O_2 with an equal part of water applied in a continuous stream.

(*b*) Weak *potassium permanganate* solution applied by continuous irrigation I have found to give excellent results. Potassium permanganate is also an oxidizer.

(*c*) Another method is to leave the wound absolutely exposed to the air. I have had two excellent results by this method of large lacerated wounds of the buttock.

(5) *Iodoform.*—Iodoform I have placed under a separate heading, as I have seen it used so seldom, and also because it is not considered an antiseptic at all by many. Although it does not kill or inhibit the growth of bacteria, it breaks up the products of the bacteria, and in so doing is itself decomposed, iodine being liberated, and then a certain degree of inhibition of bacterial growth occurs from the presence of free iodine. Iodoform, since it is not an antiseptic itself, should be sterilized thoroughly before being applied in the form of a powder. The sweeter smell of the wound is a great comfort to the patient after iodoform is applied, and although some object to its smell, they prefer it to the foul odour they have been accustomed to for a few days.

(6) *Rest.* — Hiton many years ago emphasized the great advantage of rest and comfort. In the treatment of wounds which are lacerated, immobility does give great relief to the patient and also prevents further damage to the tissues and the mechanical spread of organisms along tracts. Even in the smallest of wounds, if it is impracticable to immobilize with splints, rest in bed is of the first importance to their speedy healing and recovery.

(7) *Serum Therapy.*—Lastly, in treating septic wounds, the use of vaccines is, I consider, of great importance. A mixed vaccine of streptococcus with *Staphylococcus albus* and *S. aureus* and *B. coli* acts with great benefit in reducing the septicæmia and remarkably quickly reducing the amount of discharge. Autogenous vaccines give a much quicker and better result; but if this is impossible, the stock vaccine supplied should, I think, be employed in every case.

Sir Almroth Wright has shown some most interesting and

important facts in connection with the action of vaccines on emigration.

Summary.—In summarizing, it is of importance to remember the action of the anaerobic organisms, and to act quickly and thoroughly surgically where signs of gas gangrene are evident. In other words, large incisions, with the use of the sharp spoon, which gives extreme help in opening up and exposing the recesses not opened by the scalpel. Of all antiseptic treatments, I have always had the best results from continuous irrigation with weak antiseptics, H_2O_2 or normal saline. In referring to normal saline, it is of interest to note the increased emigration of polymorphonuclear leucocytes induced by physiological salt solution, as has been reported by Sir Almroth Wright.

A REPORT ON A SERIES OF RELAPSES IN AN EPIDEMIC OF ENTERIC FEVER.

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It is a well-established fact that in the early stages of typhoid fever a septicæmia exists, usually before the fifth day and onwards for a varying period. It is also certain that a second septicæmia exists during the relapse of such fevers. Cummins[1] states that "*B. typhosus* can be isolated from the blood of cases practically constantly at all periods previous to the formation of agglutinins in appreciable quantity, that is to say, up to the seventh day in ordinary cases, until much later in severe cases with retarded production of antibodies, and during relapses where the agglutinins undergo a temporary decrease."

In this connexion the results obtained by blood culture in a series of relapses may be of interest. The cases reported upon are drawn entirely from Belgian civilians and refugees admitted into the Malassise Hospital and include all age-groups of both sexes.

Children (up to and including 14 years) ..	20 per cent.
Men	36 ,,
Women	43 ,,

Bacteriological Diagnosis.

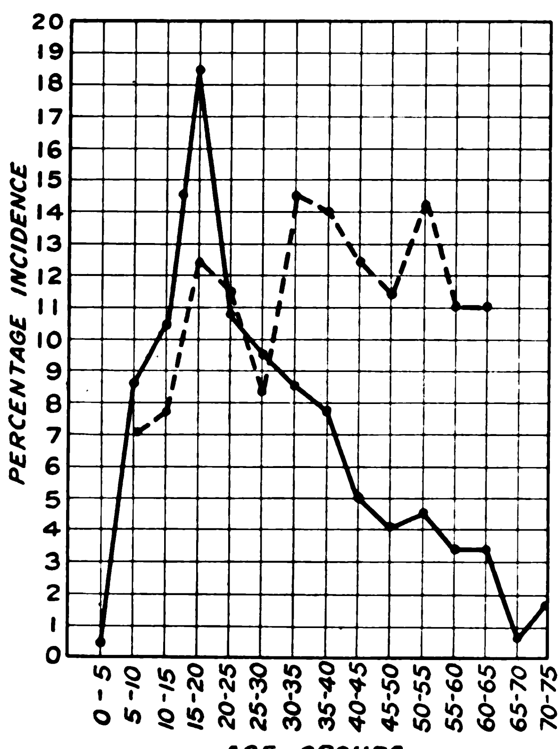
In the 650 cases of enteric fever reported upon, it is desirable to state on what evidence the diagnosis rests. In some 160 cases the bacillus has been recovered either from the blood in the acute stages or during a relapse from the excreta, spots, or post-mortem from the gall-bladder, liver and spleen. While affording no absolute distinction it may be mentioned that the *B. typhosus* was recovered eight times as frequently as *B. paratyphosus* B (142 to 18). The great majority of cases were admitted to this hospital during the later acute stages or completely afebrile, and in these cases, if uninoculated, the bacteriological diagnosis rests on agglutination tests alone; a dilution of 1 in 100 of the serum in *B. typhosus* infections and 1 in 500 in para. B infections being taken as a standard; further, the microscopic method was used. This must

[1] "The Causation and Prevention of Enteric Fever in Military Service," Journal of the Royal Army Medical Corps, June, 1913.

necessarily exclude some convalescent previously inoculated cases, who may have had enteric fever and in whom no additional evidence as to the nature of the illness was forthcoming; the exclusion of this latter group renders the percentage incidence of relapse too high.

CLINICAL DIAGNOSIS.

The diagnosis of relapse here rests chiefly on the evidence of the temperature chart. Following a period of apyrexia after subsidence of the fever of the acute attack, a bout of continued fever lasting at least six days, the onset of which was either abrupt or "step-like" with or without two other classical signs—namely, enlargement of



——— Proportional incidence of typhoid fever in 650 cases.
- - - - - - Proportional incidence of relapse in each age-group.

the spleen and a roseolar rash—was held to be sufficient evidence of a true relapse. In four cases the afebrile period was short, two to three days, or a gradual waning and waxing of the temperature was observed, i.e., an intercurrent relapse.

Frequency.

In the 650 cases relapse was noted in 78 cases, i.e., 12 per cent. As aforesaid, this percentage is a little too high. One relapse only in 71 cases; two relapses in 7 cases. No case of more than two relapses in the same case occurred.

The chart illustrates the recognized susceptibility to infection in youth and early adult life, the age-group 10 to 25 containing nearly half the total cases. In the age-group 0 to 5, one relapse in a total of three cases. In the age-group 65 to 70, two relapses in a total of four cases. The diminished incidence during the later years of life makes the percentage incidence of relapse during these periods appear abnormally high.

Sex.

As might be expected, no essential difference was noted.

Temperature.

The average duration of the fever of the relapse was fifteen to sixteen days, the longest period being thirty-five days (Case 53); the shortest (blood culture positive) six days (Case 74). The longest period of apyrexia between two relapses was fifty days; in each relapse the blood culture was positive (Case 34). The temperature reached on an average 103° F. (42 out of 77 cases). Higher temperatures, 104° and 105° F., were usually associated with rigors.

Blood Culture.

Out of forty-six cases a positive result was obtained in thirty-seven cases (Eberth's bacillus thirty-five times, para. B twice), i.e., eighty per cent gave a positive culture. The duration of the septicæmia cannot be determined from the figures available.

Case No.	Duration of relapse in days	Day of blood culture
72	32	23rd
70	20	12th
32	18	14th
8	12	10th

Clinical Features.

In recording the cases, an attempt, where possible, has been made to summarize the chief concurrent clinical phenomena of the relapse, e.g., abdominal distension, enlargement of the spleen, roseolar rash. The expression "no notes" implies that none of

Serial No.	Name	Age	Probable duration of illness on admission	Period of apyrexia	Probable week of relapse	Duration of febrile period of relapse in days	Highest temperature recorded. Deg. F.	Blood culture	Organism recovered	Day of relapse on which blood culture was made	Further afebrile period	Clinical features noted during the relapse
1	G. F.	2	3 weeks	5 days	6th	15	104·4	–	..	..	30 days	Stools typical.
2	J. C.	5	..	..	6th	15	100·4	+	Eberth	?	20 ,,	No notes.
3	G. C.	8	6th week	Febrile	6th	12	102·4	+	,,	10th	20 ,,	Spots ; spleen palpable.
4	M. C.	9	6th ,,	20 days	9th	8	102·4	+	,,	6th	30 ,,	No notes.
5	M. C.	9	2nd ,,	9 ,,	9th	12	103·8	+	,,	6th	40 ,,	Intermittent pulse ; tremors ; anorexia.
6	L. V.	10	5th ,,	Febrile	5th	15	103·8	+	,,	5th	50 ,,	Meteorism ; no spleen.
7	E. D.	10	3rd ,,	7 days	5th	25	104	+	Neg.	9th	..	Diarrhœa ; hæmorrhage.
				20 ,,	12th	14	104	–	..	..	..	Stupor ; mania.
8	J. M.	10	2nd ,,	3 ,,	3rd	12	103	–	..	..	40 days	Roseola ; no meteorism.
9	J. C.	11	3rd ,,	5 ,,	7th	15	103	+	Neg.	3rd	20 ,,	Cystitis ; meteorism ; rash doubtful.
10	D. V.	11	7th ,,	21 ,,	8th	16	101	–	..	..	30 ,,	Meteorism ; spleen + ; roseola.
11	M. C.	12	3—4 weeks	10 ,,	7th	8	102·4	+	Eberth	3rd	..	Roseola. Died miliary tuberculosis.
12	A. B.	12	4th week	14 ,,	6th	7	101·3	+	,,	2nd	30 days	Meteorism.
13	T. R.	12	4th ,,	20 ,,	7th	18	102·8	+	,,	7th	30 ,,	Absence of P.S.
14	A. L.	12	6th ,,	14 ,,	8th	12	104	–	..	..	30 ,,	Roseola.
15	J. S.	12	6th ,,	19 ,,	10th	9	102·8	–	..	..	30 ,,	No notes. T.U.C.
16	A. H.	13	5th ,,	20 ,,	10th	12	102·8	–	..	..	80 ,,	Roseola ; T.U.C. ; meteorism.
17	J. V.	14	4th ,,	10 ,,	6th	16	103·4	+	Eberth	6th	30 ,,	Headache ; abdominal pain ; meteorism.
18	G. V.	14	4th ,,	5 ,,	6th	20	102·4	+	,,	7th	50 ,,	Absence of P.S.
19	G. L.	15	3rd ,,	?	10th	10	101·8	–	..	..	35 ,,	No notes.
20	F. L.	16	10th ,,	Febrile	10th	11	103	–	..	..	35 ,,	Absence of P.S.
21	C. F.	16	2nd week	11 days	4th	16	103·2	+	Neg.	14th	30 ,,	Absence of P.S.
22	F. V.	16	4th ,,	I.R.	8th	?	104·2	+	Eberth	6th	..	No splenic enlargement ; no rash ; P.M. (acute appendicitis ; general peritonitis). Died.
23	C. K.	17	6th ,,	10 days	9th	8	101·6	–	..	..	30 days	No notes. T.U.C.
24	A. M.	17	6th ,,	?	7th	16	102·6	–	..	..	35 ,,	No notes.
25	M. D.	17	4th ,,	7 days	5th	17	105	+	Eberth	3rd	30 ,,	Absence of P.S.
26	H. L.	18	7 days	6 ,,	3rd	13	102	+	Neg.	9th	30 ,,	Roseola ; nephritis ; jaundice.
27	E. S.	18	6th week	3 ,,	7th	15	103 2	+	Eberth	5th	30 ,,	Roseola.
28	C. W.	18	2nd ,,	15 ,,	5th	15	103	+	,,	4th	40 ,,	Absence of P.S.

29	H. D.	19	9th week	6 days	10th	14	104	–	..	..	..	No notes.
				20 ,,	15th	14	104	–	..	..	30 days	Ditto.
30	M. L.	19	4th ,,	5 ,,	5th	11	103·8	–	..	..	30 ,,	Meteorism.
31	A. C.	19	8th ,,	4 ,,	5th	10	103	–	..	..	25 ,,	No notes.
32	G. V.	19	2nd ,,	8 ,,	5th	18	103·6	+	Eberth	14th	..	Absence of P.S.
				20 ,,	11th	14	101·2	–	..	..	20 days	No notes. T.U.C.
33	J. V.	19	4th ,,	5 ,,	5th	22	103·8	+	Eberth	5th	..	No notes.
				8 ,,	9th	15	102	+	,,	5th	20 days	Roseola.
										5th	..	Spleen +.
34	M. B.	20	3rd ,,	12 ,,	6th	22	105	+	,,	5th	..	Meteorism; hæmorrhage; roseola.
				50 ,,	16th	12	103·2	+	,,	4th	25 days	Absence of P.S.
35	M. F.	20	4th ,,	7 ,,	5th	15	104	+	,,	3rd	35 ,,	Absence of P.S.; faucial diphtheria.
36	E. C.	20	3rd ,,	2 ,,	4th	12	103·6	–	..	..	30 ,,	Absence of P.S.
37	M. W.	21	5th ,,	3 ,,	6th	14	102·4	–	..	..	30 ,,	Absence of P.S.
38	M. V.	22	3rd ,,	I.R.	5th	31	103	–	..	..	30 ,,	Absence of P.S.
39	J. D.	23	1st ,,	38 days	7–8	28	103·2	+	Eberth	6th	30 ,,	Spleen +; roseola; meteorism; melæna; diphtheria.
40	G. H.	23	18th day	12 ,,	5th	9	103·8	–	..	..	30 ,,	Roseola; no spleen.
41	J. B.	24	2nd week	6 ,,	4th	7	102·2	–	..	..	30 ,,	No notes.
42	J. D.	25	6th ,,	3 ,,	8th	19	103·4	+	Eberth	4th	40 ,,	No notes.
43	J. Z.	25	3rd ,,	7 ,,	4th	16	103	+	Neg.	15th	30 ,,	Absence of P.S.
44	A. B.	26	6th ,,	Febrile	6th	8	102	–	..	..	30 ,,	No notes.
45	H. V.	29	3rd ,,	30 days	8th	15	102·8	+	Neg.	3rd	..	Spleen +; roseola.
										10th	..	Cholecystitis.
					11th	21	103·8	+	,,	4th	30 days	Spleen +; roseola; thrombosis of femoral vein.
46	A. S.	29	2nd ,,	10 ,,	6th	13	102	–	..	..	25 ,,	No notes.
47	L. V.	30	3rd ,,	4 ,,	5th	16	103	+	Para. B.	4th	(?)	No notes.
48	E. E.	30	(?) 5th ,,	3 ,,	(?) 6th	21	104	–	..	..	30 days	No notes.
49	C. J.	31	6th ,,	8 ,,	8th	15	101·6	–	..	..	40 ,,	Absence of P.S.
50	J. M.	31	3rd ,,	10 ,,	6th	22	104	+	Para. B.	3rd	(?)	Spleen +; roseola; melæna.
51	A. B.	32	9th ,,	10 ,,	11th	22	104	+	Eberth	4th	40 days	Absence of P.S.
52	E. B.	32	2nd ,,	12 ,,	5–6	10	104·8	+	,,	4th	30 ,,	Roseola; meteorism.
53	M. C.	32	Acute	I.R.	(?) 4th	35	104·6	–	..	..	30 ,,	No notes. T.U.C.

ABBREVIATIONS. U.C. = Urinary carrier.
T. = Temporary.
Chr. = Chronic, i.e., still excreting bacilli: three months after defervescence.
P.S. = Physical signs, e.g., roseola; enlargement of spleen; meteorism.
I.R. = Intercurrent relapse.

Serial No.	Name	Age	Probable duration of illness on admission	Period of apyrexia	Probable week of relapse	Duration of febrile period of relapse in days	Highest temperature recorded. Deg. F.	Blood culture	Organism recovered	Day of relapse on which blood culture was made	Further afebrile period	Clinical features noted during the relapse
54	S. L.	33	5th week	8 days	8th	22	103·6	+	Eberth	4th	..	Meteorism.
				7 ,,	12th	15	103	+	Neg.	3rd	30 days	Absence of P.S.
55	F. D.	35	2nd ,,	(?)	7th	15	103	–	..	..	30 ,,	No notes.
56	E. V.	35	4th ,,	9 days	6th	26	103·2	–	..	..	30 ,,	Meteorism; roseola; no splenic enlargement.
57	P. T.	37	2nd ,,	14 ,,	5th	14	102·8	–	..	..	30 ,,	Meteorism; roseola.
58	M. P.	37	3rd ,,	3 ,,	5th	26	103	–	..	..	30 ,,	No notes. T.U.C.
59	I. B.	37	3rd ,,	14 ,,	7th	11	102	–	..	..	70 ,,	No notes.
60	L. C.	38	5th ,,	4 ,,	6th	11	103	–	..	..	35 ,,	Meteorism; diarrhœa.
61	E. W.	38	6th ,,	(?)	6th	9	103	–	..	..	35 ,,	Meteorism.
62	E. B.	40	4th ,,	2 days	5th	30	103·8	+	Eberth	6th	30 ,,	Absence of P.S.; rigors.
63	C. C.	41	3rd ,,	8 ,,	5th	15	102	–	..	..	30 ,,	Absence of P.S.
64	H. E.	42	8th ,,	5 ,,	11th	25	103	+	Eberth	4th	..	Meteorism; P.M. = enteric; died.
65	E. G.	44	3rd ,,	9 ,,	6th	20	101·4	+	,,	4th	?	No notes.
66	H. C.	46	? 4th ,,	12 ,,	? 7 to 8	10	101·4	–	..	..	?	No notes.
67	E. D.	46	2nd ,,	14 ,,	6th	10	103·2	–	..	..	..	Rigor; T.U.C.
68	V. L.	48	3rd ,,	6 ,,	6th	12	103	+	Eberth	4th	30 days	Meteorism.
69	D. V.	50	5th ,,	12 ,,	7th	22	103·6	+	Neg.	7th	40 ,,	Absence of P.S.
										18th	..	Severe bronchitis.
70	O. C.	50	5th ,,	18 ,,	8th	20	103·2	+	Eberth	12th	20 days	No notes.
71	L. B.	50	3rd ,,	4 ,,	7th	32	105	+	,,	23rd	50 ,,	Four rigors; no P.S.
72	J. B.	51	3rd ,,	I. R.	4th	29	103	+	,,	3rd	?	Absence of P.S.
73	P. D.	55	(?)	(?)	10th	10	102·4	–	..	..	40 days	No notes.
74	P. B.	56	3rd week	7 days	6th	6	103	+	Eberth	8rd	25 ,,	Absence of P.S.; T.U.C.
75	L. T.	62	7th ,,	3 ,,	8th	18	103	+	,,	11th	30 ,,	No notes.
76	B. S.	63	4th ,,	12 ,,	9th	9	101·4	–	..	..	60 ,,	No notes; T. U. C.
77	H. M.	67	3rd ,,	12 ,,	6th	15	103·8	–	..	..	70 ,,	No notes; Chr. U. C.
78	E. B.	69	3rd ,,	10 ,,	7th	14	103·2	+	Eberth	5th	30 ,,	No notes.

ABBREVIATIONS.—U.C. = Urinary carrier.
T. = Temporary.
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I.R. = Intercurrent relapse.

these symptoms have been recorded, but not necessarily their absence. In eleven cases the absence of the above signs is observed in association with a positive blood culture.

	Blood culture		
	Positive	Negative	Not made
With physical signs ..	17 ..	4 ..	9
Absence of physical signs ..	11 ..	5 ..	5
No notes	9 ..	— ..	24

In two cases the relapse synchronized with faucial diphtheria. In five cases in the whole series a bout of fever resembling a relapse was held to be due to erythema nodosum.

Post-typhoid Elevations of Temperature.

Rises of temperature to 102° or 103° F., lasting two, three, or four days without leading physical signs or symptoms, were noted in sixty cases, or nine per cent. As these "spikes" of temperature closely simulate a relapse at its onset, blood culture was made as often as opportunity presented itself, but in no case with a positive result.

As to the probable mechanism of relapse a tempting hypothesis is put forward by Cummins:[1] "As, however, the body," during an acute attack of typhoid fever, "has now to deal not only with an invasion of bacteria but also with the solution products of their body substance (toxins), it will be necessary to form not only anti-bacterial substances, such as opsonins and agglutinins, but also antitoxic substances. It is conceivable that the production of the latter class of substances may be in excess of that of the former, leading to a clinical recovery from symptoms without a complete elimination of the infective bacteria from the organs."

In conclusion, the evidence for a second septicæmia is clear, eighty per cent in forty-six probable cases; further, in several cases the blood culture had been negative in the subsiding acute stages.

There remains to acknowledge the valuable assistance given by Captain J. A. Ryle in providing and selecting the clinical material of the majority of the male cases, and to Lieutenant A. Stokes for permission to include his results obtained from the majority of the female patients and children.

[1] *Loc. cit.*

Clinical and other Notes.

SOME ILLUSTRATIVE CASES OF THE TREATMENT OF SEPTIC WOUNDS IN A BASE HOSPITAL.

By Lieutenant H. L. MARTYN.
Royal Army Medical Corps.

The problems that have faced the surgeons in the base hospitals in France during the present campaign have been many and varied, and to deal with them successfully departures from the recognized surgical methods have been inevitable. Operative procedures have been adopted which have been the means of saving many a man from fatal septicæmia but which could hardly commend themselves to an examiner in the exact art of operative surgery. The extensive septic infection of almost all wounds and the almost universal infection with the *Bacillus aërogenes capsulatus* have necessitated the freest possible means of cleansing and drainage, and operative methods have had to be adapted to the altered circumstances. Thus it was soon obvious that once emphysematous gangrene was established in a limb and amputation necessary the usual methods of operation with flap-cutting and suturing, even with the freest possible drainage, were useless and almost always resulted in the extension of infection to the stump and death of the patient. The only alternative lay in the recognition of the anaerobic necessities of the infecting organism and a reversion to the primitive direct circular amputation with no attempt to cut a flap, leaving the bone projecting from the stump and the whole freely open to the air; a method with its advantage the saving of the life of the patient, its disadvantage the necessity of a subsequent operation to remove redundant bone and form flaps.

Two cases may be quoted as illustrative :—

(1) Patient admitted May 10, 1915, with a bullet wound four inches below the knee-joint penetrating the leg from before backwards, passing between the tibia and fibula. The leg below the wound was cold, markedly swollen, bluish-black in colour and crepitating on pressure, offensive brownish pus with gas bubbles issued from the wound, and patient was in a condition of marked toxæmia. The limb was amputated immediately above the knee-joint by the direct circular method. The patient passed an uneventful convalescence and showed no signs of infection of the tissues of the stump. The appearance of the stump is shown in the first photograph when granulation was satisfactorily established a fortnight after operation.

(2) An almost identical case to the above, but the infection had not extended to so high a level and amputation was performed at the

knee-joint. The photograph (2) shows the resulting stump with the condyles of the femur projecting from the retracted tissues. The day on which the photograph was taken was three weeks after the original amputation, and on that day re-amputation was undertaken through the skin one inch above the granulating edge. Formal flaps were cut and sewn up with drainage, the operation resulting in a perfect stump uniting by first intention.

CASE 1.—Amputation of leg above knee-joint for gangrene.

CASE 2.—Amputation of leg through knee-joint for gangrene.

No less serious a consideration is the possibility of saving the limb when threatening gangrene is present. Many cases come under observation when well-marked infection with the *B. aërogenes* exists and the question to be decided is whether the life of the patient will be endangered be the effort to save the limb. Undoubtedly the responsibility is great, as if the effort fails in its object subsequent amputation may be too late to save the patient from the early and rapid septicæmia which develops in these cases. The third photograph well illustrates such a question.

The patient was admitted with a bullet wound traversing the leg from side to side three inches above the ankle-joint. The entrance and exit wounds were small and blocked with caked blood. A little offensive brownish pus with gas bubbles escaped from the outer wound on pressure.

The foot was much swollen; over the greater part it was bluish-black in colour, on the dorsum greenish in hue, with the dark veins showing prominently through the skin; marked emphysematous crackling was present on the dorsum of the foot. Round both entrance and exit wounds the skin was absolutely black for a small area, and subcuticular blebs full of blood were present below the inner wound. It was obvious that gangrene of the entire foot was threatening, but inasmuch as the patient's general condition was good an effort was made to save the limb.

Both entry and exit wounds were freely opened up. The fibula was found to be fractured and the back of the tibia grooved; the posterior tibial artery was found divided and ligatured after turning out a large mass of blood-clot.

CASE 3.—Bullet wound above ankle-joint: threatened gangrene.

CASE 4.—Bullet wound of knee-joint: arthrotomy.

A large drainage-tube was inserted with some "tabloids" of salt, and the wound packed with gauze soaked in peroxide of hydrogen. The foot was then freely incised, all subcutaneous tissue being gelatinous, brownish-black, and containing free gas.

Hydrogen peroxide dressings were employed, and for as long as possible the foot was kept in the open air under only a single layer of gauze.

Within two days the swelling had entirely disappeared and the foot resumed its normal colour, comparatively little sloughing of subcutaneous tissue occurring.

It has been argued that in these cases better results are obtained by incisions transverse to the long axis of the limb, obtaining thereby a greater lymph exudate. This is certainly a point to be considered, but against it must be weighed the fact that the subsequent scarring of a number of transverse incisions cannot but interfere to a considerable extent with the lymphatic and venous return from the limb.

The dressings of greatest value in these cases is also a point for consideration. Much is to be said in favour of Wright's hypertonic saline, but from a considerable practical experience of its use I am still inclined to prefer the free use of peroxide of hydrogen, employed both on dressings and by hypodermic injection combined with prolonged exposure of the wounds to sun and air.

CASE 5.—Bullet wound of knee-joint: acute suppurative arthritis: arthrotomy.

Much has been written on the treatment of septic wounds of the knee-joint, and very great judgment must be exercised, especially when the case is complicated by the presence of a retained fragment of metal.

When infection is early and mild and the fragment easily accessible it may be reached by an anterior incision by the side of the patella, and the sepsis effectively dealt with by washing out the joint with saline and subsequent drainage to a similar parallel incision by a drainage-tube behind the patella. Drainage by tubes should be continued for as short

a period as possible, and the wounds allowed to close immediately the effusion subsides. Photograph (4) illustrates such a case.

The patient was admitted with a shrapnel ball lying between the condyles of the femur. There was considerable effusion, but pain was not acute; temperature 102° F., pulse 100. The photograph shows the treatment as suggested above. The shrapnel ball was readily removed through the inner incision. The joint contained blood with some pus but few bacteria; no streptococci were detected.

Drainage was maintained for forty-eight hours by a tube passed behind the patella and the joint irrigated with saline. The photograph was taken three weeks after operation, the joint was then entirely shut off, free movement was possible, and the wounds were granulating. On the other hand, if severe infection is present, especially when the metal fragment is difficult of access, or when it is embedded in one of the condyles, no alternative exists to a complete arthrotomy if the limb is to be saved. Drainage in any other way will be insufficient to deal with infection. An example of such a case is shown in photograph (5).

The patient was admitted having had his left leg amputated above the knee-joint for extensive injury. It was six days since he had been wounded and the right knee-joint was found to contain two fragments of metal, one embedded in the internal condyle. The patient's condition was bad, the joint was distended, acutely tender, and discharging large quantities of pus through one of the wounds; temperature 102° F., pulse 120. Complete arthrotomy was performed by a semilunar incision below the patella dividing the ligamentum patellæ. The crucial ligaments were divided and the cartilages removed. One fragment of shrapnel was found free in the joint and the other removed by a gouge from the substance of the condyle. The interior of the joint was in a condition of acute inflammation and contained pure pus. The leg was put up fully flexed and gradually extended.

The photograph was taken two weeks after the operation with granulation well established. The patient's condition improved immediately after the operation and his temperature fell to normal within four days. Five weeks after the operation the entire surface was covered with healthy granulation tissue and no discharge beyond slight serous exudate. Under the circumstances it was decided to make an attempt at arthrodesis.

The patella was accordingly excised. The granulations which had entirely replaced the cartilage on the articular surface of the tibia were carefully scraped away. A very thin shaving was removed from the femoral condyles and all granulations well scraped off. The limb was brought into a position of full extension and the flap from which the patella had been removed sewn over. Two drainage-tubes were placed behind the bones, one in front and one passing upwards beneath the skin flap. The flap united by first intention, the two anterior tubes were

removed within ten days; within three weeks of operation there remained only the two posterior tubes, from which there was nothing but slight serous discharge. The temperature is steady and there appears no reason why the somewhat, at first appearance, unlikely possibility of primary union should not take place.

Although the method appears ideal from the point of view of ease of dealing with the sepsis if there is extensive bone injury associated with the suppurative arthritis, the infection may be such that amputation is the only alternative, moreover, it has the great disadvantage that a subsequent operation is necessary to ensure a rigid bony union between femur and tibia.

I am indebted to Quartermaster-Sergeant R. C. Blair, R.A.M.C., for his assistance in the preparation of the photographs for publication.

A CANVAS SLING FOR LOADING WOUNDED FROM BARGES AND BOATS INTO HOSPITAL TRANSPORTS.

By Lieutenant-Colonel PERCY HOPE FALKNER.
Royal Army Medical Corps.

The loading of wounded from boats and barges into hospital ships and carriers forms one of the many problems that require very close attention at the present time; and we maintain that it is a matter which should concern the officer in charge, and not be left to chance, or vaguely considered as solely the business of the ship's crew.

The problem may be stated thuswise: A patient, utterly helpless, who requires protection from injury during transfer. He lies upon a stretcher in a boat or barge probably some considerable distance from the ship's deck, and generally hidden from view so far as the man who operates the winch is concerned.

The boat may be a small one—for instance, a stretcher lying thwartships over the after-well of a naval pinnace—and its motion will vary from a condition of steadiness to that of incessant motion according to conditions of weather. Further, the ship herself may be rolling considerably; and yet it is just possible that the patients must be taken on board at all costs.

(1) *Safety.*—A heavy cradle lowered away under unfavourable conditions proves at once unsuitable, and no small handicap to efficient loading.

It is difficult, and sometimes impossible, to land it safely on a small boat; or into a barge the decks of which are covered with stretchers so closely packed that there is little or no room to place the cradle. We have more than once seen narrow escapes notwithstanding every care as regards the winch.

(2) *Speed of Loading.*—The method, as carried out by means of a

wooden cradle, is not sufficiently rapid for average requirements. It may, for the reasons stated, be dangerous to lower away; therefore the process must necessarily be slow. The loading of the patient into the cradle is a clumsy and awkward operation that causes unnecessary delay

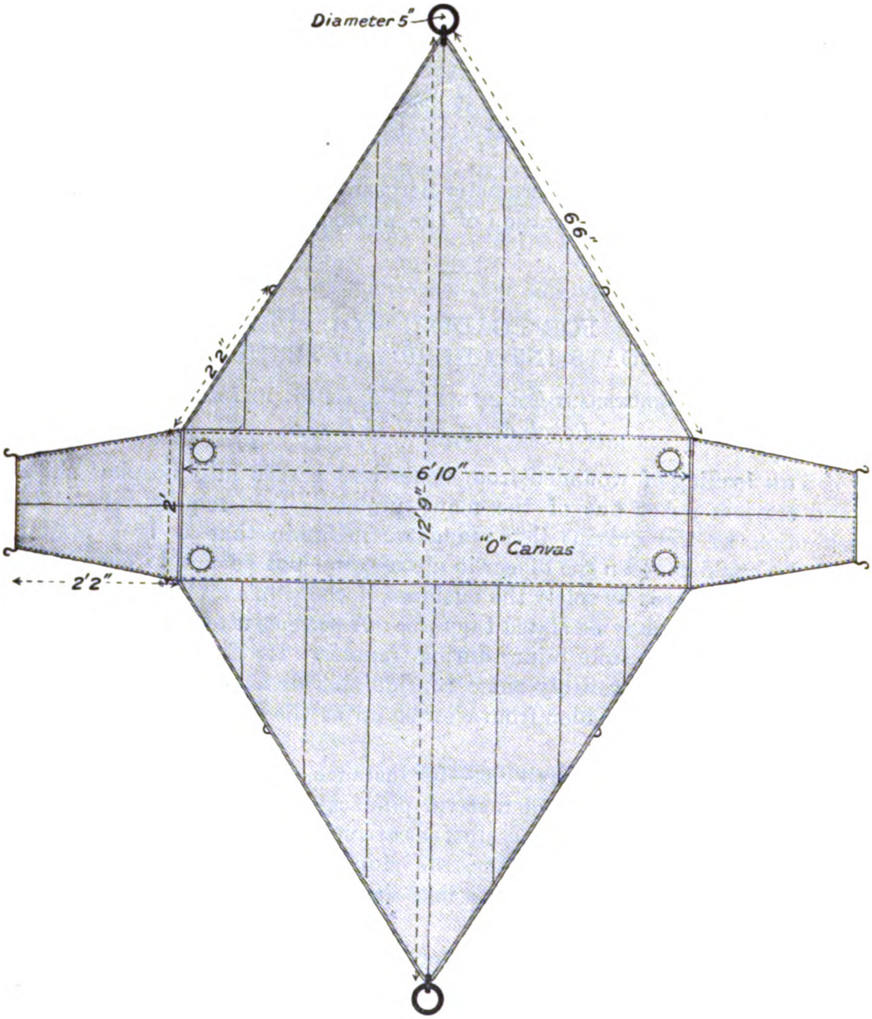


FIG. 1.

of the winch—an important point to remember, as it is usually only feasible to operate one cradle at a time, namely, that on the lee side of the ship.

SOME DISADVANTAGES OF LOADING BY MEANS OF A WOODEN CRADLE.

(3) *Labour Wasted.*—The labour of loading and unloading a cradle should be considered for obvious reasons: the staff may be small, and the day a long and arduous one for them.

To try and overcome at least some of these disadvantages a simple canvas sling was devised, and, after practical demonstration, found to exceed the best that was expected from it.

The contrivance is composed of "O" canvas, one inch pliable wire rope, two five-inch iron rings, and four small hooks to secure the end flaps (fig. 1). Wood does not form any part of the sling, and we are satisfied it should not do so.

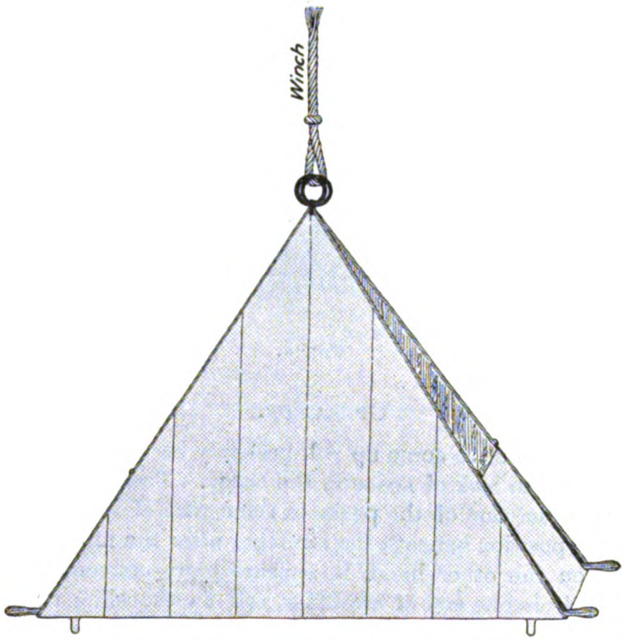


FIG. 2.

THE CANVAS LOADING SLING.

The base measures six feet ten inches by two feet: just sufficient to cover the under surface of the regulation stretcher, and allow its four feet to enter the round holes at each end.

From ring to ring the sling measures twelve feet nine inches, while two feet two inches is a good length for the two end flaps. These flaps are hooked up to four eyelets, located on the edges of the triangular sides, so that they pass between the stretcher handles when the stretcher is in position, and the iron rings are approximated to take the winch hook.

The diagram (fig. 1) illustrates a complete circumference of wire rope for the body of the sling. It should, of course, pass inside a casing of canvas and not be merely sewn to the edges of the cloth; it takes, practically, the whole weight of the stretcher.

Fig. 2 illustrates the stretcher in position, and safe from all risk, provided the winch is operated in a reasonable manner. The inward pressure upon the two stretcher poles is probably no greater now than when the patient is carried by hand; so that the traverses have no tendency to collapse. Should they do so, there is no risk involved.

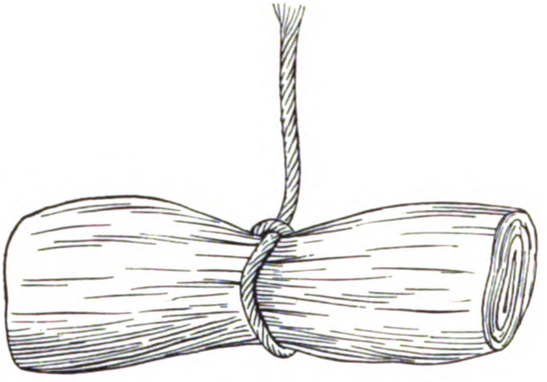


Fig. 3.

OPERATION.

The first stretcher to come up will probably be the most difficult one to handle, owing to lack of space in the barge. Therefore the sling may be rolled up from one of the peaks to the centre of its floor and passed sideways into position beneath the stretcher after the manner of a "draw sheet." If, on the other hand, it appears more convenient to slip the canvas under from one end of stretcher, roll up the sling crosswise from one flap to the other and place it so that the four feet are taken into the holes provided for them.

No time is lost. One after another the slings are fitted to the stretchers in the boat, while the empty slings coming from the deck above do so as small compact bundles (fig. 3) that cannot injure any one. In practice, and working without great skill or effort, it will take about one minute to land each patient on the ship's deck—more than twice as fast, and with half the labour, as compared to the cradle method.

When the patient reaches the deck (fig. 2), two bearers take the stretcher handles without stooping, while the winch rope is slackened off to unhook the rings. The sling is then rapidly cast off, and falls to the deck while the bearers move forward with their patient.

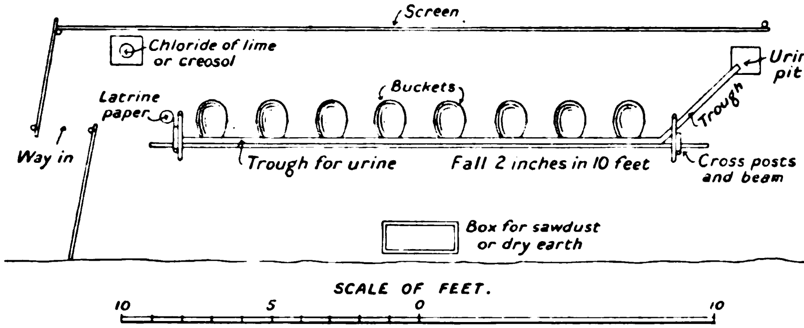
This represents our practice on the Hospital Ship "Salta" at the present time, but modifications as regards the method for operating this sling may suggest themselves in the future.

NEW LATRINE FOR USE IN CAMPS.

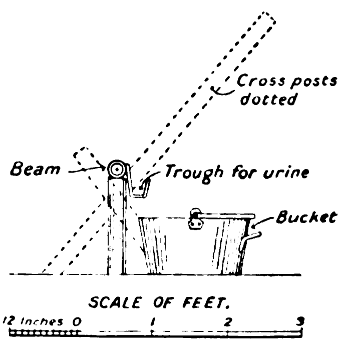
By Lieutenant-Colonel A. D. SHARP.
Royal Army Medical Corps (T.F.).

That incineration is the safest way to deal with excreta in camps is admitted by everybody. Incineration, however, has never been enthusiastically adopted, chiefly because of the unsatisfactory method of keeping the fæces and urine separate. The two receptacle idea, the seat with two

Diagram of latrines for keeping separate urine and fæces.



Plan of latrines.



Detail section through urine trough.

holes, and other devices, so far as my experience goes, had only to be tried to be discarded as unworkable.

I have devised an arrangement which acts automatically and needs no attention. A seat in the form of a stout pole supported on forked uprights

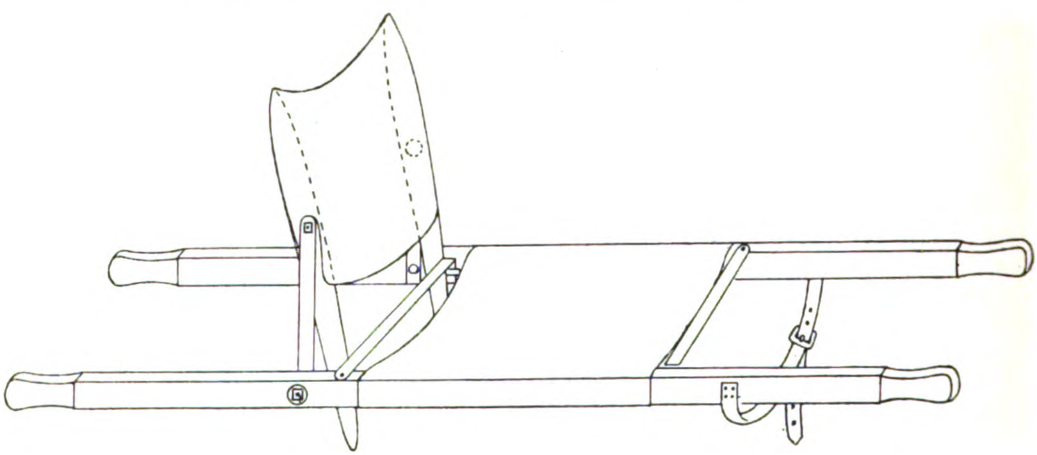
is erected with a fall of two inches in ten feet towards one end. A small trough is made out of biscuit or other tins, and nailed to the posterior surface of the pole. The free edge of the trough, which is rounded, projects about four inches behind, and is about four inches lower than the the upper surface of the pole. The urine trough empties into a pit or receptacle at the lower end towards which there is a fall of two inches in ten feet. The fæces drop dry into the bucket, while the urine is caught in the trough and flows along to the pit or receptacle at the end. The pole seat is rubbed over with paraffin and the trough is flushed down with cresol solution daily. This arrangement has been in use at the 49th (W.R.) Divisional Rest Station for a considerable time and works perfectly. Many other units have copied this method and find that it has solved a long-standing difficulty. The accompanying diagrams require no explanation.

CHAIR STRETCHER.

By Lieutenant J. S. GOODACRE.

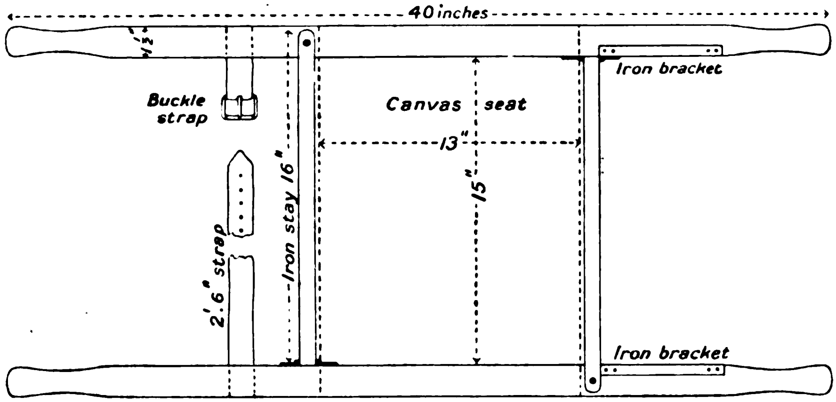
11*th Battalion, King's Liverpool Regiment.*

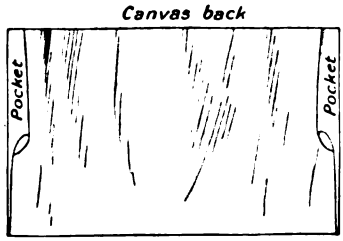
This stretcher was designed to enable wounded to be withdrawn from the firing trenches. Being of short length (only forty inches) it can be carried around any traverse or zig-zag communication trench. By the use of the strap for abdominal cases the knees of the patient can be kept



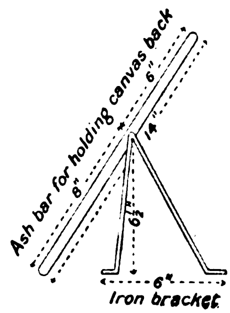
Rough sketch of stretcher.

pressed into the stomach, enabling these cases to be carried successfully. A broken thigh can be lashed to the handle. It is not intended that the patient should be carried the whole of the way to the dressing station on this stretcher, but only up to the point where the regulation stretcher can come into service.





Pocket on each side to slide over ash bars like rooka chair back.



Designed and constructed by J. S. Goodacre, Lieutenant, 11th Battalion, King's Liverpool Regiment.

Detail of trench stretcher chair: 2 shafts of oak or ash, 40 inches by 1½ inches by 2 inches; 2 stays or spreaders, iron, ¾ inch by ¼ inch by 16 inches, plus 1½ inches right angle bend; 2 iron sockets, ¾ inch by ¼ inch by 3½ inches; 2 iron brackets of ½ inch by ¼ inch by 16 inches, bent to shape; 1 canvas seat, 20 inches by 13 inches; 1 canvas back, 16 inches by 10 inches; 2 ash bars, 14 inches by 1 inch (in centre tapering to ¾ inch at each end) by ½ inch; 18 screws; 2 bolts and nuts, 1 inch by ¼ inch; 1 leather strap, 1¼ inch by 2 feet 6 inches; 1 leather strap, 1¼ inches by 6 inches, with buckle end.

GASTRIC JUICE AND THE PREVENTION OF ENTERIC FEVER AND CHOLERA.

By Lieutenant-Colonel N. FAICHNIE.
Royal Army Medical Corps.

With the commencement of fighting under conditions of temperature such as those at present prevailing in the Dardanelles, I venture to predict that after the usual eight weeks—the so-called eight weeks' phenomenon—there will be a good deal more disease of the enteric group than we have had up to date in France or Belgium.

It is true that our sanitary measures are very complete, but it seems to me that we do not take enough advantage of the power of the gastric juice to act as an antiseptic—a known and admitted fact. Microbial poisons differ from chemical ones in that the former have incubation periods and are much more uncertain in their action, which means, I take it, that the mere swallowing of microbes is of no importance unless they have an opportunity to take root and grow. Let me give as an example an occurrence related in the text-books that has always impressed me very much.

Many years ago, a portion of a cholera stool got mixed up with four gallons of water, and was left to stand in the sun for some hours. Early next morning 19 men each drank an ounce of this mixture, and 5 of them developed cholera; that is to say 14, or 73 per cent escaped entirely, although they must have swallowed enormous numbers of cholera bacilli. It seems probable that in those who escaped, the cholera bacilli, which are well known to be very sensitive to acids, were killed by the hydrochloric acid of the gastric juice.

We may remember that in the Tropics it has long been considered unwise to go out in the morning without eating something first. Also during the fast of Ramazan, when water but no solid food is allowed till sunset, it has been shown that Mahomedans suffer more than Hindus from cholera, although at other times of the year there is no disproportion.

Here, then, we have a principle which seems to be of great importance, viz., that the longer the bacilli of enteric fever and cholera remain in the acid stomach the more likely they are to be killed, and unless they reach the alkaline small intestine alive they can do no harm. The newer physiology teaches us that if water be taken on an empty stomach, it leaves it again almost immediately, also that the clotting of milk in the stomach is a provision of Nature to allow of gastric digestion.

On the other hand, solid food may remain in the stomach for several hours, and leave it slowly, though the observation of bismuth meals shows that the food may begin to move very quickly. Other things being equal, then, it seems probable that the more fluid taken with solid food the more quickly will the latter begin to leave the stomach. As the stomach is said to secrete between eight and ten pints of gastric juice a day (I quote Dr. Alex. Hill), drinking at meals is quite unnecessary.

The following rules, therefore, may safely be laid down:—

(1) For drinking. If the water is above suspicion, or if tea is available, the best time to drink is before meals, in the same way that a horse is watered before being fed. This will supply the body with fluid, and at the same time will leave the stomach comparatively dry for the reception of food.

(2) On the contrary. If the water is not above suspicion never drink it on an empty stomach, as it will pass on almost immediately and penetrate to the small intestine.

(3) If there is nothing but suspicious water to drink, take it in small quantities at a time, and then at least twenty minutes after a meal—the bigger the meal the safer it is to drink—but always drink slowly, so that each small amount taken gets well mixed with the acid of the gastric juice.

As regards eating. Bread issued once in twenty-four hours, and always liable to pollution by dust, or flies, or handling, is, I consider, the most dangerous part of a ration. The drier it is when eaten the longer it will remain in the stomach, and the less diluted will the acid or the gastric juice become. A large drink of even a safe fluid will dilute the gastric juice proportionately, and may also wash down microbes into the small intestines before there has been time for them to be killed.

Just before the War broke out I had arranged to make some experiments in order to try and get bacteriological evidence in favour of these statements, but I was unable to carry them out. As the statements stand, they may be of some value, and considering the good water discipline of some regiments, it should not be difficult to carry out the principle.

MALIGNANT ENDOCARDITIS AS A COMPLICATION OF EPIDEMIC CEREBROSPINAL FEVER.

By Lieutenant W. WRIGHT MACKARELL.

Royal Army Medical Corps.

Amongst the complications of epidemic cerebrospinal fever malignant endocarditis is not mentioned in the current literature, so that the two cases about to be described are apparently unique. They both occurred in the late epidemic and strangely enough were together in the same ward. The one, the first, was diagnosed several weeks before it proved fatal, but the other, for reasons which will be explained later, was not recognized until the post-mortem.

Case 1.—F. W., aged 19, soldier, previously quite healthy, was admitted to hospital on February 20, 1915. He complained of violent headache; he had a foul tongue, Kernig's sign was well marked, there was no rash and no head retraction. His temperature was 99° F., which later went to 101° F.; his pulse was 104. On the following day there was a slight subcuticular hæmorrhagic rash; he was lumbar-punctured and twenty cubic centimetres of Burroughs Wellcome and Co.'s antimeningococcic serum injected into the spinal canal. The fluid drawn off was turbid, and smears showed large numbers of polymorphonuclear leucocytes, and a very few Gram-negative intracellular diplococci, which on culture failed to grow. Following the lumbar puncture the temperature fell to 98° F., the pulse to 66, and the patient felt much better. The following day

his temperature rose to 102·6° F., the pulse to 116, and the rash became much more marked. His temperature varied between 102° and 98·6° F. for the next three days, and on February 25 ten millions of meningococcic vaccine were injected. (This vaccine was prepared from the organisms from three separate cases, and was tried in several instances with, in some cases, apparently good results.) His temperature fell to 98·8° F., but shortly after rose, and on February 26 he was again lumbar-punctured and serum injected. The fluid was clear and contained only a few polymorphonuclear leucocytes and cultures were sterile. The puncture did not affect his temperature, which continued swinging between 102° F. and normal. On March 1 fifty millions of vaccine was given without result. On March 3 he was again lumbar-punctured, the fluid being quite clear, no polymorphs were present, the fluid reduced Fehling's solution and cultures from it were sterile. On March 9 ten cubic centimetres of blood were taken from the median basilic vein and inoculated into eight tubes of broth. In forty-eight hours there was a copious growth of a Gram-negative coccus which failed to grow below 23° C., fermented glucose but not saccharose. The patient was rapidly losing weight, was very pale, and now for the first time, on examination of the heart, there was a loud presystolic murmur over the mitral area. The diagnosis was then made of malignant endocarditis. A vaccine was prepared from this coccus, which was undoubtedly a meningococcus. The first dose of ten millions was administered on March 16, and was repeated every six days in increasing doses until on April 7 he received 100 millions. At first he seemed to improve after the vaccine, but later he had several rigors, and it was discontinued. He continued to run the same temperature, which was uneven and never now reached normal, and on April 30 and May 5 a vaccine of 500 millions was given without any result. He died on May 18, twelve and a half weeks after the onset.

A post-mortem was performed the same day and showed the following condition: *Brain*, *stomach*, and *intestines* all normal. *Liver* a little congested, 70 ounces; section shows nothing abnormal. *Kidneys*, right 6½ ounces, left 8½ ounces; capsule strips readily; nothing abnormal macroscopically; no infarcts; microscopically a very small amount of acute nephritis. *Spleen*, 35 ounces, full of infarcts; sections show some to be fairly old (two or three months) and others quite recent. *Heart*, 11½ ounces, normal in size; tricuspid orifice admits three fingers; left auricle not dilated; the mitral orifice would only admit a small slate pencil; it was surrounded by friable vegetations which are shown in the accompanying photographs.

Sections of a small piece of the vegetation show very large numbers of a Gram-negative coccus resembling morphologically the meningococcus. The pleomorphism of the organism is well seen in these photographs.

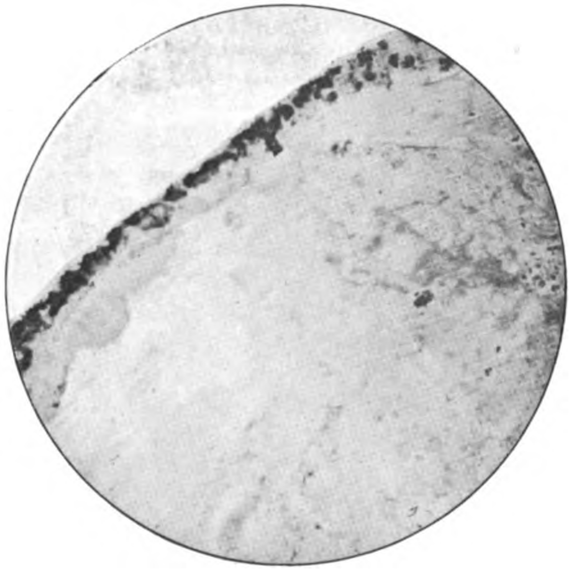
CASE I.

FIG. 1.—Looking down through the left auricle on the mitral valve which is almost completely occluded by vegetations.

CASE I.

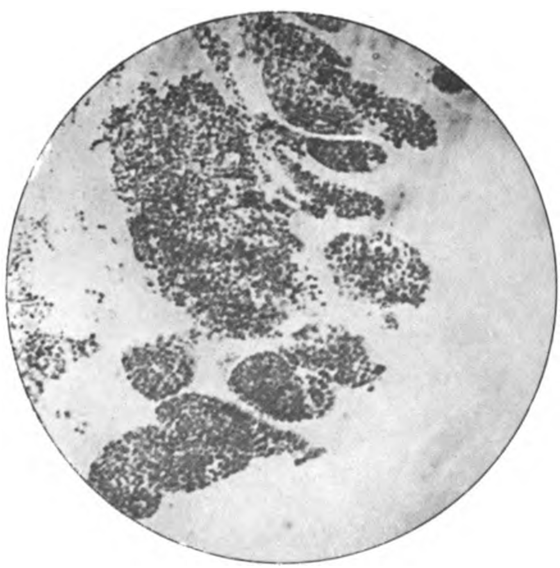
FIG. 2.—Low-power view of piece of vegetation—the black masses are groups of organisms. The small black dots are polymorphonuclear leucocytes.

To illustrate "Malignant Endocarditis as a Complication of Epidemic Cerebro-spinal Fever," by Lieutenant W. WRIGHT MACKARELL, R.A.M.C.



CASE I.

FIG. 3.—Low-power view, showing masses of organisms along the edge of a vegetation.

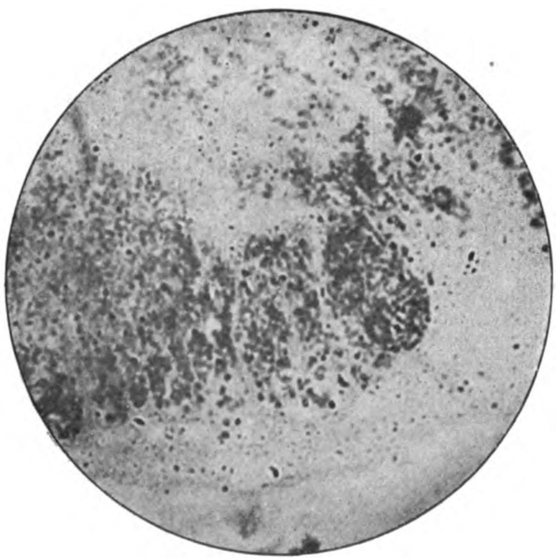


CASE I.

FIG. 4.—High-power view of the dark masses seen in fig. 3. The individual cocci are here shown and the pleomorphism of the organism is well shown.

To illustrate "Malignant Endocarditis as a Complication of Epidemic Cerebro-spinal Fever," by Lieutenant W. WRIGHT MACKARELL, R.A.M.C.

Case II.
Fig. 5.—Vegetation *in situ*.



Case II.
Fig. 6.—High-power view of organisms in section.

To illustrate "Malignant Endocarditis as a Complication of Epidemic Cerebro-spinal Fever," by Lieutenant W. Wright Mackarell, R.A.M.C.

Case 2.—W. M., aged 53, a joiner; he was a fairly well preserved man and well nourished. He was admitted on March 26, 1915, complaining of very severe headache. There was marked head-retraction, Kernig's sign, very marked hæmorrhagic rash all over the body, tongue dry, brown and coated, spleen palpable, temperature 101·4° F., and pulse 100. He was lumbar-punctured the same day and serum (Burroughs Wellcome and Co.'s) injected. The cerebrospinal fluid was very turbid and contained large numbers of intracellular Gram-negative diplococci which grew profusely and proved to be meningococci. He was lumbar-punctured on four occasions, the last time on April 26, and serum was injected. The fluid drawn off was on each occasion very turbid and full of organisms. He was a very difficult patient to manage and would not submit to repeated lumbar puncture. An autogenous vaccine was prepared and administered every four days, beginning on April 30 with 100 millions, and reaching 1,000 millions on May 21, without appreciable benefit. From the onset he had the same remittent temperature as the previous case and died on July 14, almost sixteen weeks after the onset. Malignant endocarditis was thought of, but the condition was presumed to be so extremely rare that it was unlikely that two cases should occur at the same time in the same ward. In addition to its being unlikely, no heart murmur could be heard and there were no rigors. The failure to hear a murmur which must have been present was undoubtedly due to the marked emphysema which made it very difficult to hear the heart sounds. A post-mortem examination was performed thirty-six hours after death and revealed the following condition:—

Marked Emaciation. — *Liver*, 50 ounces, slightly pale, otherwise normal. *Spleen*, 6 ounces, diffluent. *Kidneys*, 5½ ounces each. Capsule laminated. Show chronic interstitial nephritis. *Intestines*, normal. *Stomach*, no distension, normal. *Lungs*, very marked emphysema of both; old healed tubercle in both apices. *Heart*, weight 12 ounces. There was a large vegetation on the mitral valve about the size of the terminal phalanx of the thumb, almost completely occluding the orifice No vegetation elsewhere and no infarcts in any of the organs. *Brain*, there was marked thickening of the meninges. Slight excess of turbid cerebrospinal fluid. There was pus on the upper and posterior surfaces of the cerebellum. The two frontal lobes were stuck together and there was an amount of pus in the great longitudinal fissure in this region.

Photographs are shown of the vegetation *in situ*, also photomicrographs of the organisms, which proved to be Gram-negative diplococci, present in large numbers in sections of the vegetations.

I beg to thank Captain Corfield, R.A.M.C., late M.O.H. of Colchester, and Dr. Fell, at present in charge of the Civil Isolation Hospital, Colchester, for their kindness in allowing me free access to these cases

and their great help afforded me at all times. I also beg to thank Professor E. E. Glynn, of Liverpool University, for his kindness in taking the photomicrographs of the first case.

Current Literature.

An Investigation into the Bacteriology of Dysentery in the Madras Lunatic Asylum (Civil Assistant-Surgeon M. Kesava Pai, M.D. *Indian Journal of Medical Research*, vol. iii, No. 1, July, 1915).—As the dysentery of armies in the field closely resembles the type prevalent in asylums, this paper is of some interest at the present time.

The opening paragraphs of the paper consist of references to other papers treating of the incidence of the bacillary type of the disease both in this country and in India. The summary of these paragraphs is as follows:—

In this country observers have already proved that asylum dysentery is exclusively bacillary in type, and that with the exception of six cases in which the Shiga bacillus was isolated by Eyre, all the others have been found to be due to the mannite-fermenting types. At El Tor in Arabia, Ruffer and Willmore isolated mannite-fermenting types from all cases but one from a large number of pilgrims suffering from the disease.

In India, on the other hand, amœbic dysentery is much more common, and among the bacillary types occurring the Shiga type of bacillus is more common than is the case in this country. In 81 cases of bacillary dysentery investigated by Forster most of the infections were due to the Shiga type, the Y bacillus being the next most common. Of 14 strains isolated by Wells at Hazaribagh Jail, 4 were of the Shiga type, 9 Flexner, and 1 Y bacillus. Of 13 strains isolated by Greig and Wells, 4 were of the Shiga type and 9 Flexner. They observed that in the bacillary cases the organism could only be detected when there was blood or mucus in the stool, and that the excretion of bacilli was sometimes intermittent. All these observers remark on the unreliability of the agglutination test in diagnosis.

The author then describes the work carried out by him on cases in the Madras Lunatic Asylum. Of 136 cases examined for bacillary dysentery from the beginning of 1911 to the end of November, 1914, 54 gave positive results. The Shiga bacillus was responsible for 18 of these, and mannite-fermenting bacilli for 36. Of the 82 negative cases 20 were examined in the diarrhœa stage, and were not passing any mucus or blood. The technique employed in the examination of the stools was as follows:—

"A little mucus from the stools was rinsed in three successive watch-glasses, each containing sterilized normal saline to free it, as far as possible, of the coli organisms normally present in the stool. With a sterilized bent glass rod as spreader, the material was then rubbed well over the surfaces of three MacConkey's plates in succession, without charging the rod a second time. The plates were incubated for twenty-

four hours, at the end of which time the non-acid colonies were sufficiently evident in the midst of the red colonies of the different types of *Bacillus coli* normally present in the fæcal discharge. Though the rule was to find the acid colonies considerably larger in number than the non-acid colonies there were instances when the plates were covered with an almost pure growth of *B. dysenteriæ*. Six to twelve of the dysentery-like non-acid colonies were then planted into a corresponding number of Durham's fermentation tubes containing neutral red, bile-salt, lactose peptone water, from which twenty-four hours later the organism was sub-planted into the different neutral red sugar media used for the classification of strains."

By this method the dysentery bacilli are easily detected in the culture from the blood and mucus, but could not be cultivated from the chronic stage of diarrhœa. Another important consideration was the time elapsing between the passing of the stool and the making of the culture, and also its method of preservation. The sending of the whole stool to the laboratory five miles away was the least satisfactory, many hours elapsing between the passing of the stool and its examination. Subsequently only the mucus was collected from the stool and sent to the laboratory in a test-tube packed in ice. This gave better results, but the best results were obtained by making the plate culture in the asylum itself.

During the course of these experiments the Shiga type of bacillus isolated both in the asylum and from patients in and near Madras invariably only produced acid in glucose and galactose. The Flexner type produced acid in glucose, galactose, maltose, mannite, and indol in sugar-free bouillon with the exception of two strains which failed to produce acid in maltose. The Y type showed a greater variance, especially with regard to their acid-producing powers in raffinose and maltose, while one strain produced acid in dulcite.

A series of agglutination reactions were carried out with the sera of patients at different stages of the attack with their own and other strains of *B. dysenteriæ*. The results obtained were unreliable and by no means characteristic.

Owing to this unreliability, not only as a diagnostic measure, but as a proof of causal relationship, the agglutination reaction of the strong polyvalent serum of the Lister Institute against the different strains isolated by the author was tried. These results were uniformly satisfactory.

All the strains were clumped by this serum in dilutions of 1 in 100 (the macroscopic method being used), and the end-point of some of the strains was as high as 1 in 2,000.

These results were controlled by non-lactose-fermenting organisms isolated from dysentery stools producing gas in glucose, a typhoid-like organism isolated from the urine of a convalescent typhoid patient, strains of *B. coli* from urine and fæces, a non-lactose-fermenting organism from a dysenteric stool, *B. typhosus*, and *B. paratyphosus* A and B. In no case was agglutination complete in a dilution of 1 in 100, and in two cases only, one of *B. coli* from a stool, and one of a non-lactose-fermenter from a dysenteric stool, was it complete in a dilution of 1 in 50.

Relapses have been seen in a number of cases in the asylum, and second attacks in the same patients due to different organisms. Having proved that the asylum cases were mostly bacillary, immunization was

tried, a polyvalent vaccine prepared from all strains isolated in the asylum being used. In 1913 a large number of the inmates of the asylum were inoculated with two doses each (125 and 250 million). The results were not satisfactory and a fresh vaccine consisting of two-thirds Shiga and one-third mannite-fermenting strains was tried. The results obtained were no better.

Twenty-six cases were investigated outside the asylum. Of these the Shiga bacillus was recovered from 8, Flexner from 2, and the Y bacillus from 5. Of the 11 negative cases 3 were proved to belong to the amœbic type.

H. G. G.

Correspondence.

NEW WOUND THERAPY.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I wish to bring to the notice of R.A.M.C. officers at home and abroad the following treatment for septic wounds:—

Mix equal quantities of pure ichthyol and glycerine, spread on boric lint by means of a camel-hair brush, and apply to the wound. Dress the wound once daily.

If there is also suppuration from a sinus, as in the case of a bullet wound, syringe out with pure sp. vini rectificat; and in this case dressing with gauze is preferable to boric lint. This treatment produces a healthy granulating surface in a few days and does not cause any irritation of the wound.

The daily dressing has a great advantage over fomentations which necessitate frequent changing and disturb the patient, besides prolonging suppuration. The less moisture about a wound the better.

I have almost discarded that barbarity the drainage-tube. The results obtained by this ichthyol treatment are most brilliant.

I am, etc.,
C. W. DUGGAN,
Major, R.A.M.C.

Military Hospital,
The Barracks, Lincoln,

No. 4. October, 1915. Vol. XXV.

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Original Communications.

PRELIMINARY NOTE ON THE CLINICAL ASPECT AND DIAGNOSIS OF PARATYPHOID FEVER.

By Captain J. A. TORRENS and Lieutenant T. H. WHITTINGTON.
Royal Army Medical Corps.

In attempting to describe the diseases known as paratyphoid fever, it must be remembered that it is only within quite recent years that any considerable amount of work has been done on the subject; that very little has been published in this connexion, and any statements now made are largely the result of impressions received while observing some three or four hundred cases of paratyphoid fever in the 14th Stationary Hospital, and may require modification when the material is more fully investigated and scientifically collated at the end of the War.

Paratyphoid fever is a disease caused by one of two bacilli, and is therefore known as "paratyphoid A" or "paratyphoid B," according to the particular organism present in any case. Both these bacilli resemble very closely the *Bacillus typhosus* in their morphology and general cultural characteristics, but in their behaviour with specific immune sera and in their reactions on certain nutrient media they differ so markedly from the *B. typhosus*, and also from each other, that there can be no doubt that they are specific micro-organisms and not varieties of the *B. typhosus* which have become modified by environment.

In 1898, N. B. Gwynne cultivated a "paracolon bacillus" from the blood of a patient "presenting all the clinical features of

typhoid fever," and this seems to be the first instance of the definite diagnosis of a case of paratyphoid fever.

This case showed throughout negative agglutination reactions with the *B. typhosus*, but the various specimens of serum were kept and were found to give definite agglutination with the organism isolated from the blood. Many cases of "paracolon" and paratyphoid infections have been described since then, and also cases of infections by other bacilli supposed to be closely allied to these.

Some German writers have contended that food poisoning and paratyphoid B infections are identical, and others have certainly confused the two diseases in their descriptions.

Bainbridge and O'Brien, in 1911, showed that two distinct organisms had been described under the title of *B. paratyphosus* B.

Bainbridge, in his Milroy Lectures of 1912, clearly showed that meat and food poisoning are due to *B. suipestifer* or *B. enteritidis*, which is conveyed to man in, and can be recovered from, infected foodstuffs, whereas paratyphoid fever is due, and due only, to one of the paratyphoid organisms, that is to say, paratyphoid A or paratyphoid B. The same writer also showed that these last organisms are in practically every case disseminated by the human carrier, and that the other cases of so-called "allied infections" were almost without exception due to one of these four organisms, and belonged to one or other of the two distinct diseases, paratyphoid fever on the one hand and food poisoning on the other.

The incidence of paratyphoid fever is greater than is generally supposed, owing to cases being missed or owing to incomplete laboratory examinations.

Paratyphoid A is well known in India, and the disease has been described and the methods of isolating the organism well worked out by officers of the Royal Army Medical Corps (Grattan and Wood, Harvey, Firth, and others) whose work ought to be more widely known. In passing it may be noted that all these observers insist on the importance of the "carrier" and therefore on the importance of the clinical recognition of the disease. Up to 1912 Bainbridge could find no record of *paratyphosus* A in England.

In America, Proescher and Roddy (quoted by Bainbridge) found that in two hundred and sixty-two patients with "enteric fever," whom they examined, eight per cent had paratyphoid A. Paratyphoid B is better known in England. Boycott some years ago suggested that three per cent of the cases notified in Great Britain were really paratyphoid B.

In Western Europe paratyphoid fever seems much more often

due to *B. paratyphosus* B, and this is certainly borne out in so far as the statistics of this hospital are concerned. In an extensive series of blood cultures made at Pretoria, Statham found that twenty-five per cent of the cases of continued fever investigated were "paratyphoid fever," both varieties of organism being isolated.

Thanks to protective inoculation and careful sanitary precautions the danger of typhoid fever proving any very serious menace to our troops in this campaign is, we believe, not great, but in so far as protective inoculation against paratyphoid is in its infancy and as yet not widely practised, though eminently desirable, the risk of our having to deal with large numbers of cases of paratyphoid fever is by no means negligible. The possible modes of infection in paratyphoid fever are many, and, just as in typhoid fever, water, food, and milk may all play an important part; but however the disease is ultimately conveyed the primary and inevitable source of infection is some one who himself has or has had paratyphoid fever. Hence it is of paramount necessity not to overlook any cases of paratyphoid fever, both from the point of view of the immediate risks from improper bestowal of infective dejecta and equally in order to avoid the possibility of letting loose a number of paratyphoid carriers, any or all of whom may initiate an epidemic of the disease.

It is especially in connexion with this question of carriers that it is hoped these few remarks on paratyphoid may be of use. For the important thing is, not to differentiate paratyphoid fever from typhoid, but to recognize it or at least to suspect its presence in what appear to be much milder conditions. These milder diseases are sure to be diagnosed again and again instead of paratyphoid if this latter name suggests to our minds only the classical symptoms of "typhoid," and this is the impression one might gather from reading the somewhat cursory remarks on the subject in many text-books.

The matter therefore is not one which only concerns the bacteriologists, since they will not be given the opportunity of examining material unless it is sent to them, and the material cannot be sent unless the patients' medical officer suspects the presence of paratyphoid. To give an instance of the truth that paratyphoid cannot be eliminated if the carrier is not eliminated it is only necessary to refer again to the incidence of paratyphoid A fever.

A number of our troops at the front came from India. Since the arrival of these troops paratyphoid A has occurred among

our soldiers out here. The great majority of the patients with this fever in our series have themselves either come from India, or have been in close association with the trocps of the Indian Divisions. Some of the cases have been Territorials or men of new battalions who in France have been attached to units from India. It seems fairly certain, therefore, that paratyphoid A has been planted amongst our troops out here by "carriers" from abroad.

How, then, is it possible to reduce to a minimum the risks of labelling paratyphoid fever, pyrexia of uncertain origin, influenza, etc.? It should be stated at once that in some few cases it is impossible even to suspect paratyphoid fever unless a thorough bacteriological examination is made; but in the great majority of cases if one is alive to the possibility of these infections one is enabled to exclude the negative cases, but only—and we cannot too much emphasize this point—by the aid of a thoroughly competent bacteriologist.

To put this in another way, it may be said that paratyphoid fever may be so mild and so atypical that only complete bacteriological investigation will reveal its presence; at the same time, even in these atypical cases there will often be some small point which is sufficient to justify one in treating them as suspects until the negative is proved, and happily it is possible to prove the negative in 99 per cent of all cases provided that the investigations are begun at a sufficiently early date. On the other hand, paratyphoid fever, whether A or B (but especially B), may in some cases be so severe as to simulate exactly the gravest and most toxic case of typhoid fever. Such cases are described in every text-book and are familiar to everyone.

It is the more atypical and very mild cases that principally concern us in this paper, for they are the cases that are most likely to be confounded with influenza, simple chill, "trench" fever, rheumatism, and other diseases with similar titles which are really little more than confessions of ignorance.

In the first place, it is more than unprofitable to attempt to discriminate clinically between paratyphoid A and paratyphoid B. A lucky guess may be made, but that is all. Suffice it to say that typically paratyphoid B is a ten to eighteen day fever, while the average paratyphoid A as seen in this hospital lasts three to four days longer than this. The temperature in both forms shows a characteristic disinclination finally to settle down, but the symptoms in paratyphoid A tend to be even milder than in paratyphoid B. If all the very mild cases were diagnosed the average

duration of fever would be found to be less than that above stated. This we think is especially true of paratyphoid A.

Clinical Diagnosis.

The clinical phenomena which may lead to the classing of a case as "suspected paratyphoid" will now be considered in more detail. To clear the ground it may be suggested that one fertile source of error seems to be the assumption that a case cannot be one of the enteric group which does not present a more or less "typhoid" appearance, or at any rate some abdominal disturbance in the direction of pain or diarrhœa.

The onset is usually by no means the gradual affair which one is accustomed to associate with the classical descriptions of typhoid fever. It is true that the majority of the cases when pressed will admit to feeling out of sorts for two, three or more days, but for all practical purposes many of them are not ill until the day on which they are compelled to report sick. Two main groups may be recognized. The first (60 per cent of the cases) comprises those who feel increasingly ill for a variable number of days (the average being four) before they report sick. The second (40 per cent of the cases) comprises those who are bowled over in a few hours or collapse in the course of their ordinary duties. A man develops a headache, has slight abdominal pain with a couple of days diarrhœa but does not report sick, for, as he says, he "thought he would get over it." The diarrhœa does pass off but backache with generalized aching pains and headache (especially the last) persist and even get worse, till by the fourth day he is so weak and ill at ease that he reports sick. Such a case is typical of the first group.

In the second group, a man may go to sleep feeling well but he wakes up with abdominal pain, diarrhœa, and severe headache, feels feverish and has a shivering attack, and in a few hours becomes so extremely weak that he is quite obviously too ill to carry on.

The similarity of this type of onset to that seen in many cases of influenza is worthy of note. If this sudden onset occurs while the man is on duty in the trenches or on the march, we get the history of sudden collapse, "legs giving way," fainting, etc.

As the result of an analysis by one of us of one hundred cases of paratyphoid B, and fifty cases of paratyphoid A, taken without prejudice from our series, it is found that there are eight symptoms which occur in at least twenty per cent of the cases at the onset. In order of frequency these are :—

(1) Headache (eighty-five per cent).
(2) Diarrhœa (fifty-five per cent).
(3) Abdominal pain (thirty-five per cent).
(4) Aching pains in the limbs (thirty per cent).
(5) Shivering (twenty-five per cent).
(6) Extreme general weakness (twenty-five per cent).
(7) Backache (twenty-five per cent).
(8) Epistaxis (twenty per cent).

Headache is usually vertical is distribution, though a migrainous type, especially severe behind the eyes, has been present in several cases of paratyphoid A. Of course, headache may be a leading feature in practically every acute infection, but the predominance of headache over the other symptoms is certainly worthy of notice. Eighty per cent of all cases will voluntarily mention severe headache as a symptom of the onset.

Abdominal pain is rarely severe or colicky and is usually generalized, and does not commonly last more than two or three days. Sometimes in cases with very rapid onset it may be severe and associated with nausea and vomiting. Typically it is not more than a general feeling of uneasiness in the abdomen.

The *initial diarrhœa* is in marked contrast to the constipation which is so common after the end of the first week. It is rarely severe, being usually limited to three or four loose stools *per diem.* If one is lucky enough to get the case in this initial stage the motions will be found to be fairly typical of the "typhoid" variety of stool. Otherwise observation of the stools gives little help in diagnosis.

Pain, other than abdominal pain or headache, is usually referred to the back or limbs. "Pain all over" is a description often given. Joint pains, reminiscent of acute rheumatism, have been a feature of some cases, but no swelling of the joints has been detected.

Extreme general weakness is often very sudden in its onset and sometimes this and headache are the only symptoms. It accounts for many of the cases of sudden collapse, though of course there is a suspicion in such cases that the case may have been ambulatory without previous symptoms.

Epistaxis is rarely volunteered by the patient as one of his symptoms. This is because it is usually so small in amount. Its value as a positive sign is very great and it occurs as frequently in paratyphoid as it does in typhoid fever. It may occur during sleep, and sometimes it may be found to have occurred in the earliest days of the onset or even before when the patient was feeling quite well.

While *shivering* is liable to occur in the course of any infection with the liberation of toxins or bacteria into the blood-stream, yet the occurrence of repeated shivering attacks seems of special significance at the onset of paratyphoid fever. This is especially true of paratyphoid A, in which shivering occurred in nearly thirty per cent of cases at the onset and in which it is liable to occur with rigors throughout the disease (*vide* Chart 6). Two cases from which the bacillus of paratyphoid A was isolated stated that they "thought they had ague."

Other symptoms which may not rarely be complained of or elicited are, in order of frequency: cough, nausea and vomiting, loss of appetite, dizziness, deafness, constipation.

Cough is complained of in nearly twenty per cent of cases and seems more common in paratyphoid B, but is rarely troublesome. It is certainly much less frequent than is the case in typhoid fever, and in view of the almost universal habit of smoking to excess in the British Army it is probable that in a number of the cases the cough is not a manifestation of the paratyphoid fever.

Vomiting is far more common in paratyphoid fever than in typhoid fever. This is especially so in paratyphoid B cases, in which vomiting occurred in seventeen per cent. In association with severe abdominal pain and severe diarrhœa it occurs in that type of paratyphoid B which simulates food poisoning in its onset, that is about three per cent of all cases of this variety.

Dizziness and deafness occurred in seven per cent of all cases. Deafness would possibly have been found more commonly had it always been asked for, as it is usually transient.

Sore throat or hoarse voice as evidence of laryngitis or pharyngitis occurred only in five per cent of the cases, all those being cases of paratyphoid B. It was present only in those severe cases which tend to simulate the toxic type of true typhoid fever.

As regards the *temperature during the onset*, we are not able to speak with great certainty, as cases do not usually reach this hospital until the seventh day or later. Patients who had a rapid onset have said that their temperatures were 102° F. to 103° F. when first taken. Cases which have started in a hospital where the patient was being treated for some wound and where the temperature was being taken as a routine measure show a rapid rise, the maximum usually being reached in forty-eight hours. Such a case is shown in Chart 7. It seems fairly certain that the "step ladder" rise so frequently seen in typhoid fever is far from common in paratyphoid.

General Course.

Although a careful history is of the utmost importance, when all is said and done in this direction the main data for diagnosis are often only to be obtained by a thorough examination of the patient. The objective features, which may be observed in an average case of paratyphoid fever in the second and third weeks, will therefore be considered.

The aspect of the patient, if seen in the early days, will tell one much. There is then a peculiar *heaviness* except in the mildest cases. This is of considerable significance, but is rather difficult to describe. One finds the terms "lethargic," "heavy," "drowsy," "inert," applied to the condition. This appearance, we imagine, can usually be distinguished from the bright-eyed flushed appearance which is associated with most of the febrile states. The condition is, however, rarely so well marked as in typhoid fever. The patient can, except in the quite severe cases, be roused up to give a clear history. In forty per cent of the cases the patient is flushed, but the eyes are dull, with the pupils often rather dilated. The chief complaint will be headache, or possibly backache. While about sixty per cent are of this type, there are two extremes. On the one hand there is the fairly large group of mild cases (twenty-five to thirty per cent) which often look and feel fairly well by the second week, and are certainly not at all suggestive of enteric fever. There is the other smaller group (ten to fifteen per cent) which are obviously ill, toxic-looking, and mentally blurred. These are the cases that will probably be diagnosed as enteric fever in any case.

The temperature during the second week in the average case ranges between 99·2° F. and 102·4° F. This produces a "spikey" temperature chart, which is very characteristic (*vide* charts, especially Chart 2). Sixty per cent of the cases analysed showed this remittent type of fever, while about twenty per cent were intermittent (*vide* Chart 12). A "spikey" temperature chart with variations of at least 2° and more is therefore seen *in eighty per cent of all cases.* A really steady temperature in the second week was only seen in five per cent of cases. Seventy per cent of all cases of paratyphoid B and forty per cent of paratyphoid A are of twenty days' duration or less. In about thirty per cent of all cases of each form the pyrexia lasts fifteen days or less (*vide* Charts 1 and 7). In the average case the temperature in the second week and at the beginning of the third week does not reach as high as 103° F. (*vide* Charts 4 and 10). Only about thirty-five per

cent of all cases of paratyphoid fever ever reach 103° F., and only about twelve per cent reach as high as 104° F.

The pulse is one of the most important aids to diagnosis. The rate is uniformly slow, as compared with the temperature. While a relatively slow pulse in typhoid fever is common enough, this feature is still more marked in paratyphoid fever. A temperature of 102·5° F. with a pulse of 70 is characteristic, and is more than significant of a group infection. The pulse, while almost always comparatively slow, varies in its slowness. Without any apparent change in the general condition, the rate may be at one time 65, and at another 85 or 90, and, curiously, a high temperature may coincide with a low pulse-rate and vice versa. The quality of the pulse is very important, as it is so characteristic. There is a most marked *softness* or compressibility present. This is noted in quite eighty per cent of the cases. About fifteen per cent only of the cases show dicrotism, but when present it is almost pathognomonic of an enteric group infection. A slow dicrotic pulse in a man without the typical general appearance of enteric fever strongly suggests paratyphoid fever. The blood-pressure in a small series of cases examined by one of us with the sphygmomanometer was found, as might be expected, to vary from 80 to 100 c.mm. Hg. Some of the lowest blood-pressures were found when the temperature was just reaching normal. This phenomenon may therefore be of use in cases which are not met with till late in their course.

The tongue often gives valuable assistance. In nearly all cases it is dry during the acute stage, and in the severe cases it is exactly like the tongue of a severe typhoid, dry, brown, and cracked. Even in the milder cases the tongue is fairly characteristic. It is dry, furred, and the fur is distributed in two dorsal slabs, leaving a red tip and red edges, and often a red band up the centre. The red tip is often smooth and glazed in marked contrast to the rough fur. The fur is not so persistently brown, as in typhoid, but is frequently thick and dirty white in colour. On the whole, the presence of a "typhoid" tongue, without the other general appearances of typhoid fever, is fairly frequent, and in these circumstances is very suggestive of paratyphoid fever.

Spots are present in as many *as seventy-five per cent* of all cases some time during the disease. They appear in crops, and last three to four days, as in typhoid fever. Owing to the circumstances in which we get the cases, it is difficult to find the average day of the disease on which they first appear. It is probably about the seventh to tenth day, and they may continue to appear as late as the

thirty-fifth day. In twenty per cent of the cases spots are present after the temperature has reached normal. This is of importance in those rapid mild cases which are not seen until the stage of defervescence is reached, since the presence of spots does not seem to bear any close relation to the severity of the disease. The spots are larger and much more irregular in outline, and of a deeper red colour than those of true typhoid. If scanty, they are seen only over the lower ribs in front, and on the flanks, and on the back of the shoulders. Fortunately paratyphoid spots are usually fairly definite things, and because a doubtful case does not suggest "enteric" it is most unwise to neglect examining for them. The spots may be very profuse, sometimes they may be minutely vesicular, and occasionally acneform. The rash of paratyphoid A especially tends to be very profuse, and may be rather morbiliform. Cases have been sent to the hospital with profuse paratyphoid rashes, which have lead to the diagnosis of measles, german measles, chicken-pox; and in one case even small-pox was suggested without, however, much reason.

The abdomen is not nearly so informative as in true typhoid. Frequently it is absolutely normal in appearance and feel. In over sixty per cent of the cases there is no distension whatever. However, in a fair proportion of cases (about thirty-five per cent), the belly can be described as "full," "tumid," or "slightly distended," and in these cases there is a suggestive soft elastic feel about it. Tenderness on palpation is rare, and pain is rarely complained of by the time a patient reaches a base hospital. Gurgling in the cæcal region on pressure is rare. Pain when feeling for the spleen or in the left lumbar region is suggestive and is present in about ten per cent of all cases. Marked distension is very rare and is only seen in the few very severe cases.

Enlargement of the liver and tenderness over the gall-bladder, unless cholecystitis is present as a complication, are conspicuous by their absence.

The spleen is either palpable or enlarged to percussion in nearly sixty per cent of cases; it can be felt in about thirty-five per cent of all cases some time during the course of the disease. When felt, the paratyphoid spleen seems to be firmer in consistence, and remains palpable for a long period (possibly by reason of this greater hardness) than it does in typhoid fever. On the whole, too, it seems less tender. The value of a palpable spleen is tremendous, and it is just as often present in the quite mild cases as in the more obvious ones, and therefore, like the spots, should

be sought for always. Owing to the frequency with which it occurs in a quite undistended abdomen, the paratyphoid enlargement is comparatively easy to make out. Again, too, it is easy to exclude malaria and the blood dyscrasias in the average patient, and other causes of enlarged spleen are very rare.

Examination of the heart is negative.

Examination of the lungs will show bronchitis in less than thirty per cent of the cases. Severe bronchitis only occurs in about five per cent of the cases and then only in that type of case resembling true typhoid which is not likely to be missed.

The central nervous system shows no constant abnormality. A very few cases have simulated meningitis, and from every point of view it is desirable to do a lumbar puncture to settle the question without delay. Only once has a paratyphoid meningismus closely simulated cerebrospinal fever, and in this case the spinal fluid was quite clear, sterile, and free from pus cells.

Defervescence.

In the third week the temperature of the average paratyphoid case reaches normal, while even if fever continues beyond the end of the third week there is nearly always a decided improvement in symptoms. It is quite common to see a case of paratyphoid fever with a temperature ranging up to 102° F. or even 103° F. lying on his side reading the newspaper, quite clear mentally and ready for a joke (*vide* Chart 2). This, of course, is in marked contrast to true typhoid fever. It has been remarked that paratyphoid B is a fever of about sixteen to nineteen days, while paratyphoid A as seen in this hospital is longer. This is due to a characteristic tendency for the temperature in paratyphoid A to take a long time to settle down and a tendency to be remittent and to recrudesce just when settling down, although the patient's general condition is obviously improving. This is well seen in Charts 2 and 5. Most of the cases which are apparently rather severe and which simulate typhoid characteristically take a sudden turn for the better and markedly improve after being in hospital from three to five days, and this quite apart from any measures other than dieting and nursing (*vide* Chart 9). It is important to recognize this feature, otherwise it may be attributed to certain treatments adopted. The termination of the fever is often characteristic. The temperature tends to settle by modified crisis or by short lysis lasting little more than two days (*vide* Charts 4, 7, 10, and 12). It is certainly rare to see the steady, long-drawn-out

defervescence so common in typhoid fever. The pulse is the chie and almost only reliable guide to the actual condition of the patient. As long as the pulse is below 90 and not too soft in quality, it matters not how high the temperature is. A pulse persistently over 100 nearly always means a serious infection. Distension and severe bronchitis are also apt to mean a serious case.

An endeavour has been made in the preceding remarks to describe the signs and symptoms which may be met with in paratyphoid fever.

To recapitulate, in a doubtful case the most important individual features are, probably :—

(1) An onset of about four days with malaise, pains in head, back, and limbs, a tendency to shiver, and abdominal discomfort with a short period of looseness of the bowels.

(2) A soft pulse which is strikingly slow in relation to temperature.

(3) An enlarged spleen (not necessarily palpable).

(4) A fever lasting upwards of a week to fourteen days.

Now if you can observe a case from the onset and can keep a temperature chart from the commencement, it is comparatively simple to say at the termination of the disease that the patient has probably had either mild typhoid or paratyphoid fever, but, unfortunately, this is rarely possible. Of course, by the tenth or twelfth day there will probably be spots or enlarged spleen or other unequivocal evidence, but there may not be anything so desirable and it is then that a careful history is so important.

A typical case to treat as a suspect would be somewhat as follows: The patient reported sick eight days previously with headache, pain in the limbs, and constipation. On questioning he will admit that for three or four days before reporting sick he had been off his feed and felt generally out of sorts with a distinct tendency to shiver at odd times, and very probably there will have been for about forty-eight hours looseness of the bowels, perhaps not amounting to true diarrhœa, before he actually was ill enough to go sick. On examination the patient may very likely look a trifle lethargic and may cerebrate somewhat slowly. His tongue will show dorsal furring with pink or red edges and tip, but may be quite moist. The abdomen may be a trifle tumid and elastic. There may be vague discomfort in it or even tenderness under the left costal margin. The splenic dullness will probably be elicited more readily than in a normal individual. The temperature will be about 101° F or 102° F. at night with a morning remission of

about 2° F. or more. The pulse will be 70 to 80, of small volume, and very compressible. The stools will be constipated and the bowels only opened with enemata. There may or may not be an occasional rhoncus in the chest. The patient himself will probably say that he is "in the pink."

Such a case is likely to be paratyphoid fever and should be treated as such.

Complications and Sequelæ.

It is possible for paratyphoid fever to show all the complications and sequelæ which are found in typhoid fever. There is, however, a marked difference both actual and relative in the frequency with which they occur in the two diseases.

They will now only be described in so far as they are liable to affect the clinical aspect of paratyphoid fever.

Broncho-pneumonia and meteorism are perhaps the commonest complications of typhoid fever. Capillary bronchitis or broncho-pneumonia has not occurred in more than four per cent of our paratyphoid cases. While rare in both paratyphoid A and paratyphoid B it seems relatively more common in the latter. Meteorism, due to paralytic distension of the large intestine, is very rare indeed and has only occurred in some of those unusual toxic cases closely resembling typhoid infection. The rareness of this complication is surprising when one considers the tendency of paratyphoid B to cause severe and extensive inflammation of the large gut.

Hæmorrhage on the contrary seems almost as common in paratyphoid B as it is in typhoid fever. Severe hæmorrhage occurs in about five per cent of all cases of paratyphoid B and was solely responsible for the death of one case, while it was a contributory cause in four other fatal cases. In two not fatal cases it was quite copious but did not seem to affect seriously the patients' general condition. It is far less frequent in paratyphoid A, occurring in only about one per cent of cases. In paratyphoid B it is liable to occur at a definitely earlier date in the disease than in typhoid fever.

Perforation (a distressing accident which no one can really forsee or guard against) has occurred in three cases of paratyphoid B and in one case of paratyphoid A, that is to say in about one per cent of all cases of paratyphoid fever.

Thrombosis of the femoral vein occurred in 3 out of 100 cases of paratyphoid B and once in a series of 50 cases of paratyphoid A. A mild, otherwise average, case seems quite as liable to this

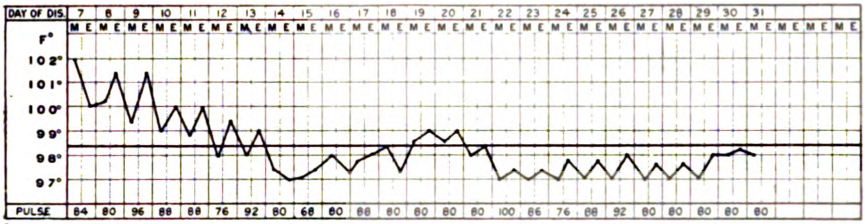


CHART 1.

Typical mild, short paratyphoid A, with thirteen days' pyrexia.

On Admission (seventh day). — No distress; sallow complexion; soft, small pulse; dry, brown tongue; firm, easily felt spleen in a normal-looking abdomen. A few typical spots. Stools "typhoid," blood culture gives paratyphoid A. No agglutination with *B. paratyphosus* A.

Fourteenth day: Feels well. Spleen just felt; no spots; agglutination with *B. paratyphosus* A, 1—100.

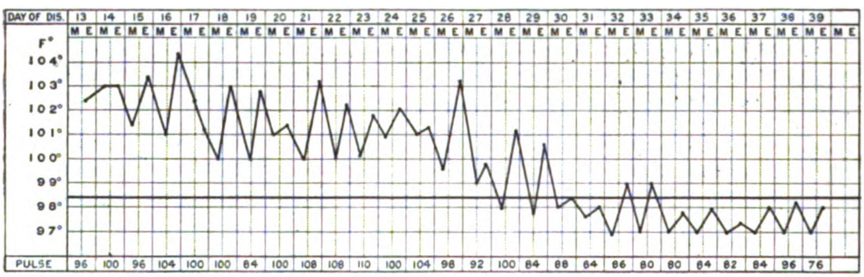


CHART 2.

Mild, but prolonged, case of paratyphoid A, with thirty days' pyrexia. Patient was cheerful and quite undistressed from thirteenth day onwards, with nothing suggestive of a "typhoid" appearance. Blood culture on tenth day of illness showed *B. paratyphosus* A.

On Admission (thirteenth day).—Sallow complexion; looks seedy, but quite bright mentally; soft, good volume pulse, more rapid than usual; moist, slightly furred tongue; abdomen negative and spleen not enlarged; a few big, well-raised paratyphoid spots; bowels constipated.

Thirty-fifth day: Feels and looks well. Many big spots.

Chart shows well a characteristic "spikiness."

complication as one of the more severe variety. It seems to begin at a relatively earlier date in the disease than it does in typhoid fever. Of four cases the left femoral was involved three times and the right once.

Amongst the other complications and sequelæ that have been met with are: Relapse, recrudescences of temperature, pleurisy, empyema, abscess of lung, pericarditis with effusion, tachycardia, laryngitis, tonsillitis, otitis media, parotitis, suppurative orchitis, neuritis, meningismus, mental weakness in convalescence, periostitis, pyelitis, cholecystitis, abscess of spleen, and peritonitis without perforation of the bowel. We would like to call particular attention to what seem to be two definite idiosyncrasies of paratyphoid B. First is a tendency (of which mention has already been made) to involve the large gut; and secondly, the special liability to pus formation. The former peculiarity is shown by the fact that the three perforations which have so far occurred in our para-

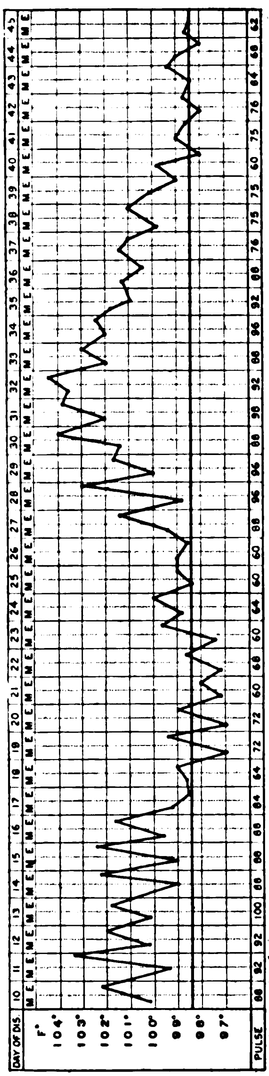


CHART 3.

Rather severe paratyphoid A, with pyrexia of average length (twenty days), but followed by relapse of fifteen days. Blood culture showed *B. paratyphosus* A on sixth day of disease and on seventh day of relapse (thirty-three days).

Sixth day: Flushed; very lethargic; very soft pulse; dry tongue, with yellow dorsal fur; a tender, "doughy" abdomen; spleen enlarged to percussion; a few typical spots.

Fourteenth day: General condition markedly improved; no spots; spleen not felt.

There were no fresh signs during relapse, which patient bore well without return of previous severe symptoms. Note the typical "spikey" temperature chart.

typhoid B cases were all situated in the large intestine, viz., one in the sigmoid, one in the appendix, and one in the descending colon. Also, it is the usual thing at post-mortems on

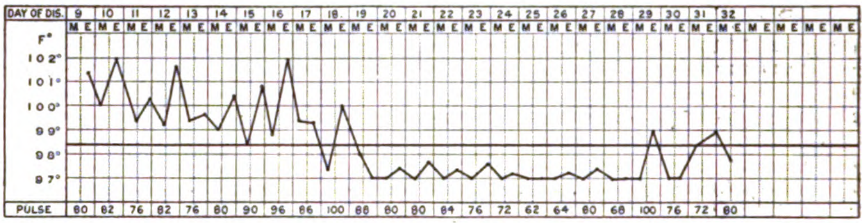


CHART 4.

Typical mild paratyphoid A, with seventeen days' pyrexia.

On Admission (ninth day).—A little flushed, but otherwise fairly normal appearance; good volume, but soft pulse; dry tongue with brown fur in centre; abdomen negative; spleen not found enlarged; several typical spots. Stools semi-formed. Blood culture shows *B. paratyphosus* A.

This case ran a typical mild, non-toxic course, without wasting or distress. Chart shows a typical remittency of the temperature.

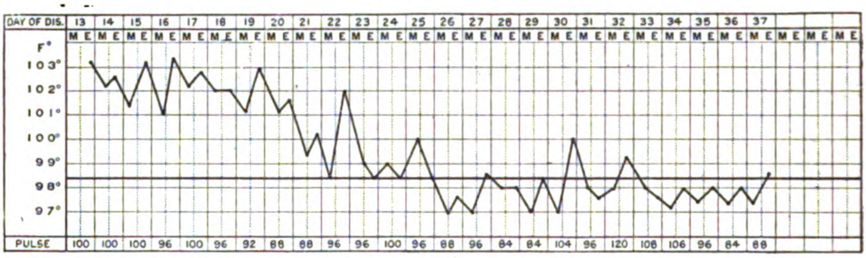


CHART 5.

Paratyphoid A of average severity, in which the temperature reached normal on twenty-third day. The pulse was rather more rapid than is usual, and there was some tachycardia in convalescence. The chart shows a rather characteristic disinclination of the temperature to finally settle.

On Admission (thirteenth day).—Looks flushed and heavy, and is disinclined to talk, but is quite clear when roused; pulse soft and dicrotic; tongue dry, rough and furred; abdomen negative except tenderness in left flank, but spleen is not made out enlarged; a few spots present; bowels constipated. Blood culture shows *B. paratyphosus* A. The general condition rapidly improved.

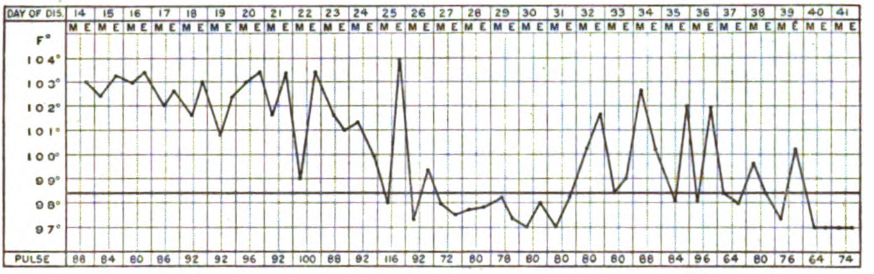


CHART 6.

Case of paratyphoid A: severe up to third week and noticeable for great irregularity in temperature, associated with rigors, and for a relapse with dry pleurisy. The primary period of pyrexia lasted twenty-six days. Blood culture (taken before admission) showed *B. paratyphosus* A.

On Admission (thirteenth day).—Flushed, "typhoid" appearance, but mental condition is good; pulse is small and very soft; tongue is dry and furred in centre; abdomen is a little distended; spleen, palpable; a few typical spots are present. "Typhoid" stools.

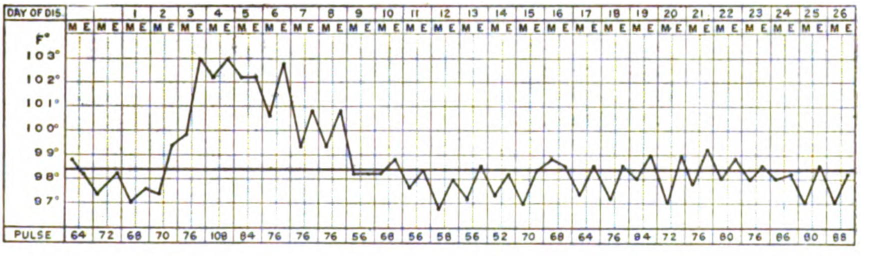


CHART 7.

Typical short paratyphoid B, showing rapid rise of temperature at onset, and quick fall to normal on the ninth day. At the time of onset patient was in hospital for bruises, the result of a shell explosion. He was up and about, when he felt cold, had headache and pains in the back, and next day temperature was 103° F. He had a discharge from the ear, and it was thought at first that this local condition accounted for the fever. He was seen by one of us on the eleventh day and sent in as probably paratyphoid.

On Admission (eleventh day).—Feels and looks fairly well. Pulse is slow and soft; tongue moist, but has brown fur; abdomen is negative; and spleen is not found enlarged. A few spots are present; bowels constipated. Strong agglutination of *B. paratyphosus* B. Both stools and urine of this day were found to contain the paratyphoid B organism.

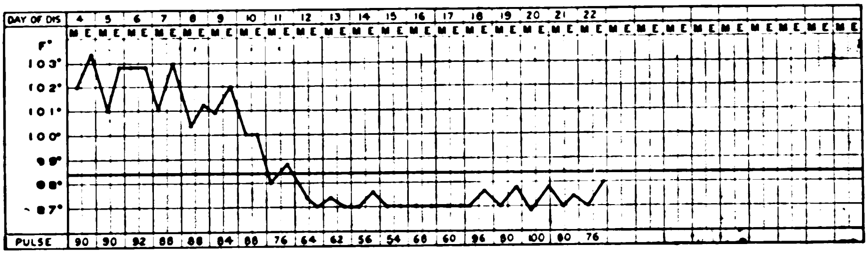


CHART 8.

Typical rather severe case of paratyphoid B running rapid course with eleven days' pyrexia.

On Admission (sixth day).—Flushed and looks feverish but is quite clear mentally. Pulse is slightly dicrotic; tongue is dry with thick dirty white fur; the abdomen "full"; and spleen not enlarged. A few developing spots are present. Bowels constipated; blood culture negative; strong agglutination with *B. paratyphosus* B.

Patient made a quick convalescence.

A blood culture taken before admission gave *B. paratyphosus* B.

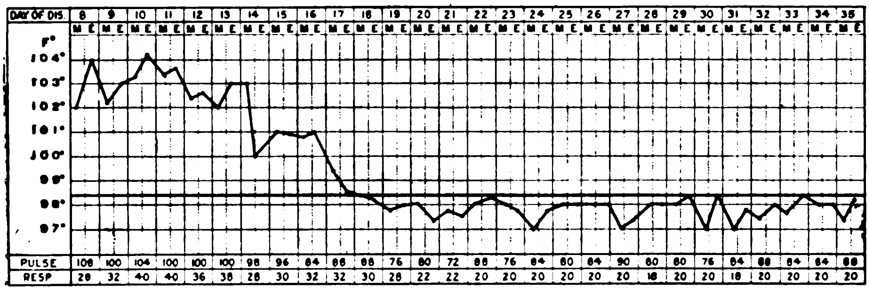


CHART 9.

A severe toxic case of paratyphoid B, which began to improve rapidly at end of second week, the temperature reaching normal on eighteenth day.

On Admission (eighth day).—Flushed, looks toxic, muttering, a little tremulous; is too ill to get history. Pulse is of big volume and very soft. Tongue is dry with yellowish-brown fur; abdomen is not distended and the spleen is felt. There are many big, well-raised spots. Bowels constipated. Diagnosed as severe paratyphoid B fever. Blood and stool cultures both gave *B. paratyphosus* B.

Twelfth day: Continues severe with rapid grunting respiration, is restless and flushed, and has a dicrotic pulse.

Fifteenth day: Better. Quiet and undistressed.

Patient continued rapidly to improve and made a good convalescence.

cases of paratyphoid B to find the cæcum and the colon as far as the splenic flexure severely affected, and in three or four cases the solitary follicles have been extensively involved nearly as far

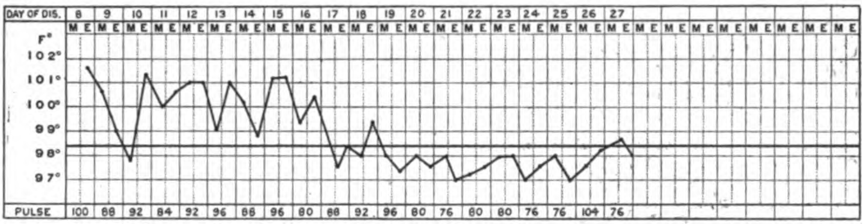


CHART 10.

Typical mild paratyphoid B, in which temperature reached normal on seventeenth day.

On Admission (eighth day).—Looks seedy, feels weak, is quite clear mentally. Pulse is very soft; tongue is dry with thick brown fur; the abdomen is a little "full"; and the spleen is not enlarged. Blood culture negative.

Thirteenth day: Spleen felt. Stool culture shows *B. paratyphosus* B. Spots were never seen. Case made an uneventful recovery.

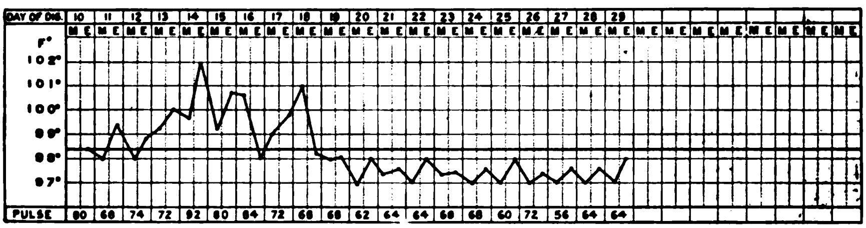


CHART 11.

Very mild non-toxic case of paratyphoid B.

On Admission (tenth day).—Patient looked debilitated, but otherwise nothing abnormal was found, and the blood culture and serum reactions were negative.

During the next few days temperature rose, and blood was again taken on the fifteenth day, and this time gave *B. paratyphosus* B, and the serum strongly agglutinated the bacillus. By this time, however, the stools sent for examination on the day of admission had given *B. paratyphosus* B also. There were at no time any definite physical signs. Presumably patient had a mild quick attack, accounting for normal temperature and the organism in the stool on the tenth day, and the febrile period occurring in this hospital, during which the organism was grown from the blood, was a relapse.

down as the rectum. The second tendency of paratyphoid B, namely, that of pus formation, is evidenced by the occurrence of the following complications, viz.: 3 cases of suppurative orchitis, 2 cases of splenic abscess, 1 case of empyema, 1 of periostitis of a rib, 1 of abscess of the liver, 1 of abscess of the lung, and the case of suppurative peritonitis above mentioned, all occurring in the course of paratyphoid B. The bacillus paratyphoid B was recovered from two of the orchitis cases, both the splenic abscesses, and from the abscesses of the liver and the lung, and from the pus around the rib.

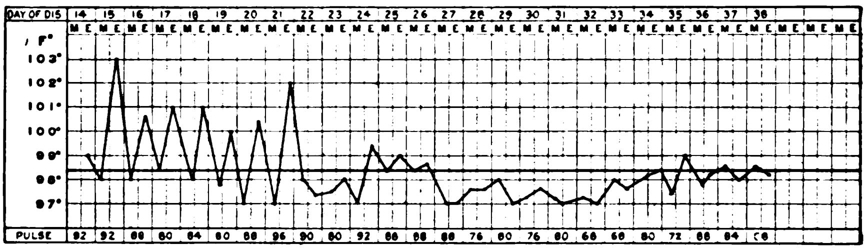


CHART 12.

Mild case of paratyphoid B fever showing the intermittent type of pyrexia.

On Admission (fourteenth day).—Patient looks poorly and feels weak. The pulse is of small volume and soft; tongue is dry with brown fur; the abdomen is sunken, and spleen not enlarged; several spots seen; bowels constipated; blood culture negative; stool culture gave *B. paratyphosus* B.

Twenty-fifth day: Fresh crop of spots. Spleen felt enlarged, and it remained so until thirty-first day.

Uninterrupted convalescence.

Relapses, etc.—The disinclination of the temperature of paratyphoid A finally to settle has already been noticed. Sudden rises of temperature, both during and after the primary period of pyrexia, are fairly common in both paratyphoid A and paratyphoid B, but especially in the former. In paratyphoid A these rises are liable to be associated with rigors which occurred in four of the fifty cases. Over twenty-five per cent of all cases of paratyphoid A show one or more of these recrudescences of fever and half of these show two or three such rises. Similar rises, which have not, however, been associated with rigors, occur in about

fifteen per cent of the paratyphoid B cases (*vide* Chart 5). The duration of these pyrexial bouts is usually about three days.

Relapses, that is to say, more serious and prolonged rises of the temperature associated with more or less of a return of the original symptoms and frequently fresh enlargement of the spleen and reappearance of spots, occur in from six per cent (of the B cases) to ten per cent (of the A cases). The relapse usually lasts from six to ten days. Examples of such cases are seen in Charts 3 and 6.

Some interesting irregularities of the pulse are met with. Troublesome tachycardia leading to prolonged convalescence occurs in about five per cent of the cases, being decidedly more common in paratyphoid A. Bradycardia is still more common but seems to be a favourable feature. It is especially frequent in paratyphoid B, occurring in over ten per cent of the cases, sometimes starting before the temperature has settled. Lieutenant Marris has suggested that some of the cases of tachycardia are due to disturbances of the splanchnic vaso-motor control, and certainly the application of a wide elastic belt has been found to do good in a number of them. He has also examined with the polygraph other cardiac irregularities such as heart-block, also auricular fibrillation and auricular flutter which would appear to be by no means infrequent but which are only temporary disabilities. It will be seen that the period of convalescence is sometimes attended by quite interesting clinical problems.

The death-rate of paratyphoid fever is very low compared with *B. typhosus* infection. The mortality of paratyphoid B is a little over four per cent and that of paratyphoid A under one per cent. It is hoped in a further paper to refer more fully to the fatal cases and to describe the morbid anatomy and post-mortem appearances. A post-mortem examination has been made in all the fatal cases except one. The causes of death in paratyphoid B have been as follows: 1 case from profuse hæmorrhage; 3 cases from severe toxæmia combined with severe hæmorrhage; 2 other cases from sheer toxæmia; 1 case from gangrenous pneumonia; 3 cases from perforation; 1 case from abscess of the spleen with peritonitis; 1 case from peritonitis without perforation; 1 case died after drainage of a localized abscess in the region of the cæcum (? appendicular in origin) and showed abscesses in the liver and also an abscess in the lower lobe of the right lung.

Two cases died of intercurrent or associated disease, namely, one from lobar pneumonia and one from cerebrospinal meningitis. This last was the only one in which no post-mortem was made

but during life the *B. paratyphosus* B was isolated from the blood and the meningococcus from the cerebrospinal fluid, thus definitely proving the co-existence of the two diseases. In all the other cases the *B. paratyphosus* B was isolated from the bile and in many of the other cases from the spleen as well. Only one case so far has died in this hospital of paratyphoid A fever. This was a rather severe case in which a paratyphoid ulcer of the appendix perforated, causing general peritonitis.

In the preceding remarks we have endeavoured to indicate the clinical phenomena which should lead a case to be classed as suspected paratyphoid; we will now mention briefly the routine measures which must be adopted in order to place the diagnosis of such a case on as sure a basis as is possible.

A positive diagnosis can be made in one of two ways. First, the specific bacillus may be recovered from the blood, fæces, or urine of the patient, and secondly, evidence may be discovered in his blood that he has acquired, or is acquiring, an immunity to a specific infection.

Before accepting the identity of any bacillus it must conform rigidly to certain cultural characteristics, it must agglutinate with the appropriate high-titre immune serum, and it must satisfy the specific "absorption" tests first advocated by Castellani. If these requirements are not all rigorously exacted there will be many instances of faulty diagnosis, especially in the case of bacilli isolated from the stools.

The recovery of a bacillus from the blood is, unfortunately not practicable so often as could be wished, for the bacillæmia of paratyphoid fever is frequently a very transient affair and cases are often not seen until too late.

The attempt should, however, always be made for the bacilli may be present in the blood as late as the twenty-third day. It is best to do the vene-puncture when the temperature is at its highest (and for this reason the evening is probably better than the morning). Five cubic centimetres of blood should be removed from a vein and placed into about ten to fifteen cubic centimetres of sterilized ox-gall; this is incubated at body temperature for twelve hours before plating out and re-incubated and replated for the next three days. In a like manner, unless one is dealing with a carrier the bacilli are most often found in the fæces and urine during the height of the disease. Hence it is advisable to send for examination three or four specimens of both fæces and urine during the first week that the patient is under observation; more

can be sent later if the clinical phenomena seem to indicate a positive diagnosis.

The second method of diagnosis is to search for the visible evidence of the immunity which the patient must have acquired or be acquiring if he has, or has recently had, the infection, and is of course the old Widal agglutination reaction. The only satisfactory method is to examine the blood for the specific agglutinins of typhoid fever, paratyphoid A and paratyphoid B on at least three separate occasions at intervals of four or five days, the first occasion being on the day of admission.

In each case the end-point, that is to say, the maximum dilution of serum in which agglutination occurs, is noted, and it is found that the strength of agglutination follows a definite curve in any recent infection. Of course, the macroscopic method is employed and standard emulsious of the micro-organisms must be used and the results must be read after a constant interval has elapsed, which interval experience has shown to be sufficient for complete agglutination to take place. The technique and the correct interpretation of the resulting curves (especially in the case of typhoid fever where protective inoculation has been practised) is a much more difficult matter than might be expected from the short description we have given, but the method adopted in this hospital is that elaborated and published by Captain Dreyer, Professor of Pathology in Oxford University.

In conclusion, we would say that, in view of the constant leucopenia which is present in all enteric group infections, a routine enumeration of leucocytes should be undertaken in all cases, though, of course this does not help in the absolute diagnosis of paratyphoid fever.

We have not found the diazo reaction to be of diagnostic value in paratyphoid fever since it appears to be absent or equivocal in all except the most severe cases.

SOME MUSINGS OF AN IDLE MAN.

By Colonel R. H. FIRTH.

To the man inclined to think for himself, and endowed with a certain gift for scribbling, there is ever the risk that he may think he is a philosopher, become a crank, and, perhaps, a bore. In submitting another article under this heading, and mindful of the axiom that *qui s'excuse s'accuse*, one is tempted to say that, although a scribbler, one is free from any hope or desire to pose as a philosopher, but ever mindful that one may be thought a crank and bore. So far, one has had no hint that readers do think thus of me, but should any critic be disposed to question the contribution of articles of this kind to our Journal, I plead the need for us all to have the widest outlook, and that these articles are but an attempt to afford light but serious reading, and aiming at the removal from our pages of the dead weight of exclusively professional papers. If one's own outlook be not warped, the following pages should be their own justification.

I.

To every doctor there have been times when he has had to contemplate or combat the sufferings of those in pain and of those distressed by sorrow. A recent incident of the kind impels me to some reflections: the more so, as certain side advantages arising out of the great evil of pain and grief are obvious to the plain man. One realizes that these advantages modify the evil in a just sufficient degree to keep the heart of the race from breaking. We live in times when there are few who have not lost their best and dearest; moreover, these are times when the dry bones of truism live again before eyes made uncritical by misfortune. To say that suffering is a pure evil is to accept a reactionary conclusion without regard to the whole wisdom of the past. On the other hand, if we regard pain and trouble as the old world regarded it, that is, as a medicine, it is difficult to avoid the thought that the doses are too large, and even now and then they would seem to act as an irritant poison.

The general effect of pain tends to unify or arouse the deep-seated and unconscious sense of sympathy inherent in everyone. Suffering seems to equalize us all and produce a homogeneity which

is not illustrated by good fortune. Imagine a third-class railway carriage full of people, and in which a careless man holding the door gets his finger nipped or shut into it. Such an incident would make the whole assembly of people gasp as in pain; but, can we think that all those same persons would have smiled with delight had a ten-pound note fluttered from somewhere into that man's hand? Most certainly not; possibly one or two would have been pleased, one or two indifferent, and one or two depressed at the thought that theirs had not been the good fortune. The incident emphasizes well the fact that homogeneity is not illustrated by fortune; what really happens is that all natural differences of temperament, of civilization, and of education are slightly accentuated by it. On the other hand, pain and suffering equalize us all. Most of us are conscious of a certain freemasonry in trouble, for there is no bond like distress. We suppose that it is the best thing about it, and, perhaps, the only good thing which those in the midst of it can appreciate. It is difficult to recall any other touch of Nature which proclaims kinship in the same degree. One is tempted to say that the suffering form, as it were, a secret society, and are revealed to each other in the cruel clear light of catastrophe. We cannot deny that joy is also a bond, but it binds less tightly and is narrow in its scope. There is an undoubted craving for sympathy in happiness, but it is neither universal nor very acute; indeed, happiness cannot be said, logically, to crave anything. When we lose our dead, we long sometimes to tell them that we are happy, and we are glad to think that they do not know how much we suffer; but where the living are concerned, we cannot double a joy by telling or proclaiming it in the same way that we can halve a sorrow. One is tempted here to think that perhaps the greater joys are seldom proclaimed or told.

These thoughts compel us to say that there is no freemasonry of happiness, for men in their ordinary moods have no instant fellow-feeling with a happy person; such a bond is forbidden by a number of accidental emotions. Envy, for instance, and something short of envy, that sudden shock of contrast between the happy person's condition and our own, leads occasionally the best of us to recognize with shame that our friend's access of happiness has moved us a little further from him, or certainly slackened our bond of sympathy. We must admit that this is a bad trait in human nature, but it is not rare, as most of us know to our shame. Again, there is that strange something which we call "form," or "taste," which acts as a complete non-conductor where happiness is

concerned. One is thinking here of the fact that it is not only the multitude which repels us in its mirth, but the happiness of an individual may often strike us as tinged with vulgarity, and when once this feeling is aroused, there is no sharing the joy of happiness. Our happiness, in the eyes of the man we think "bad form," or vulgar, may seem to be supercilious, and with the best will in the world, we cannot then impart it to him. A great many forms of enjoyment are slightly irritating to those who do not share them. I know myself how I am irritated, when seeking happiness in books, by the happiness of my family or others obtained from social life and its amenities. Perhaps, of all forms of happiness that has the widest field of action is the happiness of children; but no one envies a child, and no one despises a child. We come, then, to this conclusion: that difference of taste in pleasure divides contemporaries more effectually than it divides different generations, because contemporaries make less excuse for each other. The plain truth is that the sight of happiness often arouses contempt, not, perhaps, in the very best of us, but certainly in many who are not very bad. One realizes that how far a man can rejoice in another man's happiness or good fortune is a great test of character and one which a merciful critic should shrink from applying. Compassion may be an essential of salvation, but not of fellow-feeling.

One was thinking of pain just now: the thought arises that there are a few people in whom, as in wild animals, pain produces fierceness. Can we say that even such fierceness cannot nullify altogether the freemasonry of trouble? Yes, we can, as this very fierceness touches their friends and endows them with the power of forgiveness. A meek and a fierce person often like one another in time of trouble, whereas each detests the other in happier moments. Of course, there are some who let no one approach them in distress; they creep away to suffer and do not like sympathy. These are exceptional people, and often have generous hearts, giving readily what they cannot receive. One has said they are exceptional people, but they seem commoner than they really are, because an outward bearing of this type is somewhat the fashion in these days. Many very admirable people strive to show neither pain nor compassion, and one finds them most among those whose lot makes the realities of life seem sordid, and they seek to refine by ignoring the realities. This repellent pose of some, or unemotional aloofness, is probably the indirect descendant of the old quality of pride as known to an earlier age. Surely we see

here a throwing back to the fierce form of contempt which characterized the great of the old world. One is reminded here of an expression of Dean Swift, who spoke of those who "lose the Christian in the gentleman." We are all familiar with the type, but we know that it is an attitude generally abandoned after the first real blow of fate has knocked out self-consciousness. One has been through the stage oneself, and one comes to think that real hardness of heart is no matter of training, or ideal, or luck, or environment. If one were a cynic, one would say that a hard heart is a pure gift, but as one is not a cynic one can say that a hard heart is the only insurance against pain. It will save its owner suffering during his whole life, it will give him serenity and keep him young, but it will also deprive him of that sympathetic contact with humanity, the deprivation of which must make him a stranger in the world. That being so, it is a doubtfully splendid solitary confinement, and altogether without that community of whose members it can, and should be said with truth, "All ye are brethren." If this be so, and these musings be based on true facts, then we can see in both physical and mental pain a true freemasonry of trouble.

II.

My present lot is to live in a divisional headquarters mess, the basis of whose daily menu is the Government daily ration issue, and some of whose members are epicures. Their criticisms of our daily fare are at times amusing and exaggerated, but they make one think. It cannot be denied that most of us are all the better for having an occasional feast, but much, if not everything, depends on the feast. With important work to be done next day, it becomes a serious matter as to what we have eaten and drunk overnight. We hear much of French cooking, but it is not superior to English cooking, if it be not good of its kind; neither can we say that French wine, unless it be the true juice of the grape, is better than good English ale. The truth surely is, that to astonish our stomach occasionally is beneficial, but it must be astonished with good stuff. Any joint, closely roasted before an open fire, is better than a bad ragoût; but, unfortunately, the days of the really roasted joint have gone for ever, and our meat is baked, even though the oven be called a roaster. In this process, we suffer a loss both of flavour and wholesomeness.

Thinking of cooking brings home the thought that to preserve the natural flavour of a food is one of the chief aims of cooking.

One has just had a cup of coffee, and it is hard to repress the thought that whoever first adulterated coffee with chicory ought to have been hanged; true, some people like the mixture, but it is certainly a vitiated taste. To spoil the delicate fragance of the coffee bean with bitter chicory is on all fours with putting sugar into good claret. Then, again, our potatoes are skinned and very different from the delicious tubers of our youth, when we used to play at being pirates and make a wood fire in the fields and bake potatoes in the hot embers. To deprive a potato of its skin before cooking is just as sensible as cutting the rind off apples before baking them; the result in both cases is the same, an escape of flavour and aroma. A similar use may be made of a wood-fire to cook a trout or pike by the riverside. There is no need to "clean" them, all one did was to wrap them round with wet paper and cover them over with the glowing ashes, allowing time according to size; the paper adhered to the skin and both came off together, giving a dish hard to beat. The same culinary attentions apply to perch, gudgeon and grayling, to say nothing of carp and tench. One rarely sees these fish at table now, but why? Perhaps because we have forgotten how to cook them. Truly, the sauce hunger can work wonders, and when one thinks how cheap these fresh-water fish would be, one marvels why they are not commonly sold and consumed. There can be little doubt that all nations overlook many things that are good for food. Frogs' legs and snails are instances to the contrary, but the hedgehog is said to be a dainty morsel, and I recall a distant incident of my boyhood, when I tasted such a dish in a gipsy's camp where the animal had been baked in a field oven of clay. I do not retain the memory of my verdict of the meat, though I do remember the fearsome awe I suffered at the time of being possibly held to ransom as a prisoner. I believe that in Australia there is a big white caterpillar that is sometimes grilled and eaten, and even the locust is to some an article of diet.

Then there are the vegetables, and it is curious to note how some may be used in one country and not in another, even though the two may be contiguous. Celery, for instance, is eaten everywhere in France, both raw and cooked, but fennel, which has an even finer flavour, is used as a comestible in Italy only, where it is grown banked up with earth, so that the stalk becomes quite bleached. This is said to be done to prevent it from becoming poisonous, as it is with celery, for both belong to the same family as conium or hemlock. Many old English gardens contain large

bushes of fennel, but how often is it used by our housewives? Another good vegetable that never appears at French dinners, except in soup, is the "Jerusalem" artichoke. The name has nothing to do with the holy city of Palestine, but is a corruption of the Italian word for a sunflower. Why the French should not serve this artichoke in the same way as carrots and turnips is a culinary mystery. Again, the absence of the parsnip from Continental bills of fare may be compared with the absence from ours of kohl-rabi or the cabbage turnip. In England, we allow only oxen to enjoy it and severely pass it by for ourselves. As one sits and thinks, one realizes how the human might enlarge the borders of his diet with much advantage, though, of course, there should not be too great a mixture at one meal. For instance, the tops of nettles, cooked like spinach, are quite good; though care must be taken to discriminate between *urticaria* and the imitative *lamium*. Most certainly the culinary museum is large, and time does not allow to tell of many obsolete dishes, such as the beloved "toad-in-the-hole" of our youth, or the sucking pig. Years ago, one constantly met with saffron in certain cakes, but never now. Once, it was indispensable in the kitchen, and Saffron Walden in Essex owes its name to the large quantities of the herb grown there. It was accounted good for health, though not to be confounded with the "meadow saffron" from which we get colchicum. As Kettner remarked in his "Book of the Table," "what once rejoiced the heart of man is now only sprinkled in water to cheer the melancholy of canaries."

Apart from the kind and quality of food upon it, the mess-table makes the thoughtful man think of waste. One seldom sits down to dinner without a sense of being offered three people's food. Most of us have the kitchen's taste for superfluities, and enough never seems half so good as a little more. Horace described the happy man as the man who had enough and something over for servants and thieves. Even if we grudge it to the thieves, most of us love it because of the sense it gives us of being on the bank and not in the water. Though we may not be rich ourselves, we imitate the rich in their wastefulness. There is nothing the average servant scorns more than the house in which she is expected to make use of crusts of loaves, and in which she is forbidden to sacrifice odds and ends of meat to the gods of the dust-bin. The same menial loves the house where there is milk for the sink as well as for the children and the cat. Think, too, of our barracks and the huge daily waste of bread there. Were there a

tax on salt, perhaps we might waste less of it on our plates; it is the same with mustard. So, from trifling comments on what we eat or do not eat, the mind has wandered to the greater problem of waste, which is a problem of the table and on the same level with lust, which, indeed, is a form of waste. They are both great problems of egoism, which is more concerned with mastery than with truth or common-sense. Truly a mammon of our own conceit, upon whose altars we are willing to offer up the sacrifices of the wasted kindly fruits of the earth. *Absit omen.*

III.

These thoughts were jotted down when voyaging home on the transport "Aragon," and suggested by hearing the ship's bell sound the passing half-hours. Within each one of us there is a strong sense of the value and irrecoverable nature of the time that is fled, and each feels an incessant consciousness of the slippery tenure by which we hold what remains of it. Surely, if there is anything with which we should not mix up our vanity and self-consequence, it is with Time, the most independent of all things; all the sublimity, all the superstition associated with the various modes of announcing its flight, are chiefly attached to this circumstance; hence the great charm of the ship's bell with its practical, rugged simplicity. The great advantage of that bell and of any striking clock is, that they are, as it were, the mouthpieces of time, and impress its flight upon the ear; time thus speaks to us in an audible and warning voice. Merely visible or dumb time-reckoners suggest useful reflections to the mind; but sounds, from their intermittent nature, appeal more to the imagination and strike upon the heart. The ship's bell and the striking clock that tell the passing, and may be the coming, dreaded hour are like a voice from other worlds, big with unknown events. One recalls the sound of the tolling of a bell for death, and knows that it is but a summons, announcing not the advance of time but the approach or fruition of destiny. Filled with these thoughts, one finds it difficult to approve that unintelligible custom of ringing out and ringing in the year, for "Why dance ye mortals, o'er the grave of Time?"

Most of us know that the ticking of a clock in the night has nothing very interesting or alarming in it, though the superstitious have magnified it and read into it an omen. In a state of acute vigilance or debility, the ticking of a clock preys upon the spirits like the persecution of a pertinacious insect; and haunting the

imagination after it has ceased in reality, is converted by some into the death-watch. To me, and perhaps to many, time is rendered vast by contemplating in darkness and silence its minute portions thus repeatedly urged upon attention, much as the ocean in its immensity is composed of water-drops. On the other hand, a ship's bell or a clock striking with a clear sound is a great relief in similar circumstances; it breaks the spell and conjures up a friendly spirit in the room. One thinks at this stage of village bells at home, and one's mind is filled with a pensive or wayward pleasure which acts as a kind of chronology of early and happy days. One recalls a village spire peeping from a cluster of trees, and hears its cheery message, and as Coleridge called it, "the poor man's only music." In that village of my youth there were chimes every three hours, and they were to us all true stages in the journey of the day. They gave a fillip to the lazy, dawdling hours, and relieved the lassitude of a back-water; at noon, their desultory, trivial song told us of release from lessons, and at nine of night they sent our weary limbs to bed.

Of the several modes of counting time, that by the sundial is the most suggestive. It never obtrudes its observations and, by its stationary character, forms a contrast to the most fleeting of all things. In the home of my youth there stood a sundial, *sub dio*, and ever suggesting a connexion between the image of infinity and eternity. Near by was a bed of sunflowers, whether by accident or design I do not know, but truly each sunflower is a natural accompaniment of the sundial. One never thinks of that old sundial, or sees one in modern times, but the thought asserts itself, What better fitted to show the progress of Time, slow, silent, imperceptible, chequered with light and shade? On an old sundial near Venice is written the delightful legend, *Horas non numero nisi serenas;* but unfortunately all our hours are not serene, and if they were, we should take probably as little note of them as the dial does of those that are clouded. It is the shadows thrown across that gives us warning of their flight. Unfortunately, we are not allowed to count only the hours that are serene and let all that is not happy sink into oblivion; we find life not the replica of the sundial whereon the shadow fades as the sky clouds, and Time presents only a blank unless its progress be marked by what is bright. Still, for all that, the sundial conveys a lesson to our minds; admittedly it is a difficult lesson to act upon, but yet it stares us in the face and says, Take no note of Time but by its benefits, watch only for the smiles and neglect the frowns of fate, compose your life of

gentle and bright moments, turn always to the sunny side of things, and let the rest slip unheeded or forgotten. To some, such a philosophy of life may be, but only to the very few, and perhaps not always to their good.

And what about the ancient hour-glass? Certainly a crude and defective measurer of time, but its creeping sands are no unapt emblem of the minute, countless portions of our existence; moreover, the manner in which they glide gradually through the hollow glass and diminish in number until the last slides through, illustrates the way in which our years slip from us by stealth. To lonely people in the past, the hour-glass must have been a real "companion of the lonely hour," telling not only how rapidly time flies, but helping to fill its vacancies, or, as Bloomfield put it, "Once more, companion of the lonely hour, I'll turn thee up again." In this old chronometer, it is impossible to avoid visualizing our very existence crumbling to atoms and running down to the last fragment.

Those who have no artificial means of ascertaining the progress of time are interesting, because they are the most acute in discerning its immediate signs and most retentive of individual dates. In their characteristics we find evidence that mechanical aids to knowledge are not the exclusive sharpeners of the wits. In the savage, we strike a mentality which is almost a natural almanac, and frequently curiously accurate in its prognostication of the immediate future. Neither can we say that those who read the time and seasons by the aspect of the heavens, who count by moons, or know exactly when and where the sun rises and sets, are ignorant of their own affairs or of the general trend of events. Among peoples of that kind, the faculties are acute and not distracted by any multiplicity of inquiries beyond what befalls themselves; they present a simplicity and clearness in the knowledge they possess which bears comparison with that of others more learned and civilized. Above all things, people in such conditions of primitivity are usually very contented and happy, and afford a curious proof of the Russian saying, "Happy people never look at their watches." I know an old man, still living, who has never had a watch nor any other mode of keeping time in his possession, nor ever wished to know how time went. It is needless to say that that old man has led a simple and happy life, but he has ever had plenty to do and been withal no simpleton. He was, and is, one of those rare humans who can kill time with thought, nay, even without thinking. Just as true fame progresses in spite of the cavils and contradictions of the critics, so Time moves on the same

no matter what disparity there may be in our mode of keeping count of it.

IV.

The experiences of recent years have brought me in contact with a number of people who have been largely successful in their respective callings. Analysing their attributes and contemplating them dispassionately, one has been able to credit each and all with one characteristic and that is, they knew their world. Now, what and whence came this knowledge? Most people will say it is the fruit of experience and observation, or rather a mature practical acquaintance with men and things. It is doubtful whether this is a true definition of it, but rather that knowledge of the world is an instinct arising out of a peculiar mould of the mind. Some people seem to display this knowledge at the outset of life; others, in spite of opportunities and often dearly bought lessons, never acquire it to the end of their days. At the risk of being thought uncharitable, one inclines to the belief that to know our world is but another name for a knowledge of our own interests, a species of selfishness or manifestation of the law of self-preservation.

We all know that there are two classes of people in the world: those who consider things with a reference to truth, and those who consider them only with a reference to themselves. The former, whatever may be their requirements, wander through life in an absent-minded kind of way; the latter are ever on the alert, know perfectly well what they are about, and calculate with nicety the effect which their words or actions will have on others. These people trouble little about arguments, but regulate themselves by the current general opinion. The difference between these two classes of people is comparable to the difference between the armadillo and the chameleon—the one is shut up in a crust of knowledge, from which the shaft of ridicule and the edge of disappointment fall equally pointless; the other takes his hue from every surrounding object and is indistinguishable from them. The facts seem to be that the great secret of knowing one's world lies in a subserviency to the will of others, and the primary motive of this attitude is a watchful perception of one's own interest. It is not an art that requires a long course of study: the difficulty is in putting oneself as apprentice to it. Many a man would have turned rogue if he had known how; but the modest and retiring man could never be impudent if he would, neither can the man of sense play the fool to advantage. Some men are born to be valets just as

others are born to be courtiers; and we are forced to realize that it is not the mere resolution to act a part that will enable us to do so; the great essential is a natural genius and fitness for it. In a few words, we come back to our old copy-book line, "*Poeta nascitur, non fit.*" The one thing which keeps men honest, as well as that which confirms them knaves, is their incapacity to do any better for themselves than Nature has done for them. Similarly, if a man's convictions and principles be weak and flabby, they will yield readily to the suggestions of his own interest, and he himself relapse into what we call the man of the world, or, rather, he will never have the capacity to be anything else. From this point of view, each one of us, after repeated attempts to change characters, very properly falls back into our old path, as best suited to our genius and habits.

The question arises here, whether men grow wiser or honester as they grow older, any more than they grow stronger and healthier. One can conceive them imbibing a greater portion of worldly wisdom, and having their frivolity or flippancy tamed to the level of every-day experience; but, if the individual grows wiser as he gains experience, the world does not, and the penitent treading back his steps meets the world advancing as he is retreating. The situation seems paradoxical, but after all it is but a contest between the bad habits of society and the unprejudiced, unconscious aspirations of human nature; and this apparent "having all the world against one" is nothing but a contest with a set of local and social prejudices, with which only our interests, not truth, are concerned. Any appeal, therefore, to the opinion of the world resolves itself into the old proverb that "when you are at Rome you must do as those at Rome do." We come, then, to this, that the way to get on in the world is to be neither more nor less wise, neither better nor worse than your neighbours, neither to advance before the age nor lag behind it, but to be as like it as possible, and to reflect its image at every turn. It seems a poor philosophy, but there is much to suggest its truth and soundness. In despair, one leaves the subject for others to propose a better explanation, but consoled with the belief that, wherever there is a strong faculty for anything, the exercise of that faculty becomes its own end and reward, producing an indifference to other things, so that the best security for success in the world is an incapacity for success in any other way.

V.

A few days ago I overheard a man say, "I can't fancy how he did so silly a thing." The oddness of the phrase at once arrested my attention, and the following arguments passed through one's mind in trying to reason out wherein lay the oddity. It is obvious that most men would have said, "I can't imagine how he did so silly a thing," and that phrasing would be correct, because there is a definite distinction between fancy and imagination, since it is the unrealized feeling that if the circumstances were imagined that led to the action, they would be the right one; whereas, if they were only fancied, they would be as likely to be wrong as right. It is clear that these two processes of the mind, known as fancy and imagination, overlap because they are cognate; but there are quite separate areas on each side beyond the double boundary, and one may say that fancy deals with what is false, while imagination deals with what is true. If we look at a picture in which angels are portrayed, or, say, a child's book showing fairies, they are true because they are images of shapes which haunt and inhabit the mind of the portrayer or others, and representing the imagination or inward vision of many people and children. The pragmatical critic may say, "Nonsense, these are mere symbolical representatives of good or perhaps evil." True, but good and evil are themselves only appearances, and because they are not tangible things it does not follow that they are not true or prevent their being true. We recognize that good and evil are things we have to deal with every day, and to turn them into images is very much the same thing as writing the life of a person with whom we have been familiar, and of whom we are attempting to create a mental portrait by means of words. When we look at a picture there is not only what we see ourselves, and which the artist meant us to to see, but there is often what the artist saw and what others cannot see. The true artist is a seer or teacher, and if he puts into his picture anything that he does not see, he is not an artist because he is fancying, not imagining. By his works the artist communicates something of his own power to others, and that something is the product of imagination.

Take our own or any other profession : the triumphs of discovery and advance therein are triumphs of imagination. The imagination of Manson put Ross on the trail by which the propagation of malaria was traced; so, too, the apple falling from a tree and the steam issuing from a kettle were but the excitants that set in

motion the imagination of the men who saw them, and evolved the law of gravitation and the steam engine. In the absence of imagination, all our efforts to be unselfish or altruistic are of no avail; it is as if a man tried to cure himself of a broken leg by reading this Journal. Even in our own families, our communal happiness depends on the exercise of imagination; for otherwise people might live together in close relationship for years and yet never understand each other. Unless one class can understand another by the power of imagination, there must be class jealousy; similarly, unless the virtuous can understand the criminal, the latter will never understand virtue, and one might add that unless religious people understand each other, there must always be animosity and religious persecution.

Carrying analogies still further, we can say that whatever vision a man may have himself, it takes much of other kind of knowledge to present that vision to others. The plain truth is that imagination is the gift which, in combination with good sense and love of work, produces all the arts, and no arts are greater than poetry and painting; in lacking imagination, humanity lacks truth and beauty, it has vision neither of its own filth and folly, nor of a cleaner and wiser state. But, like every other faculty, imagination needs discipline; if it runs riot it becomes mere fancy or a thing without real value, except so far as amusement is of value. One has hinted that imagination, in the sense of imagined things, is the only reality. There is truth in this, although philosophers may not like the way it is expressed; but philosophers are always analysing language, as scientific men examine matter. Yet language is always less perfect than thought, and therefore there may be truths outside philosophy, just as there may be truths outside science. Certainly, the most enduring things that we know are good poetry and good paintings; and both these are shapes or forms of the imagination.

VI.

One happens, just now, to be living intimately with men whose lives may be said to be hardly worth a month's purchase, and yet one and all are cheery. The circumstance is in accord with one of the most noticeable results of the present War, and that is, there seems to be a remarkable diminution of the fear of death among all classes and callings. Those familiar with Meredith's writings will recall his repeated bewailing of the degeneracy of our race, and

his constant gibe that men were afraid of wounds and death. Of course, the average man would rather be alive than dead, and fully realizes all the horrors of a battlefield, but yet thousands of men and women in these times regard death with less fear than they regarded some fleeting pain in tooth, chest, or stomach only ten months ago. It would almost seem as if men were governed after all to some degree by a sense of proportion. They feel that, in a sea of deaths, to be but another ripple or wave is an accident such as is happening, or may happen, to every one alive, and that what happens to everyone is all in the day's work rather than a towering tragedy. Many feel that to die in a crowd is far less terrible than to die alone. In fact, a man said to me a few days ago that he would be afraid to drown by himself, but that he would think much less of it if he were one of a number, as on a sinking ship. This may seem extreme selfishness, but it is a common emotion or attitude, and does not involve so much selfishness as appears. Really, it comes from a feeling that it is easier to do things in company with others, or in crowds. Possibly this is but a new aspect of man's well-known gregarious habits.

It seems worth while jotting down some reflections upon this question of the fear of death. Perhaps the best cure for the sensation is to reflect that life has a beginning as well as an end. There was a time when we were not, but that gives us no concern, so why should it trouble us that a time will come when we shall cease to be? To die is only to be as we were before we were born; yet no one feels any remorse, regret, or repugnance in contemplating this last idea. There is nothing in the idea of a pre-existent state that excites our longing like the prospect of a posthumous existence. We are satisfied to have begun life when we did; we do not grieve that we did not happen to be in time to see the pageant of human life going on in some antecedent age, and yet most of us are upset at being obliged to quit the stand before the rest of the procession passes. This difference of view has been suggested as due to an innate curiosity or eagerness to know the future, which is sharpened in proportion as we are in the dark about it. The suggestion does not meet all the case: rather, one thinks it is the pang of parting, the breaking of some strong tie, or leaving some cherished purpose unfulfilled, that creates the repugnance to go. We conceive the love of life to be an habitual attachmeut, not an abstract principle.

To some, life is more humiliating than death, though one depends on the other. Probably, the most humiliating feature of

this life is that feeling, which some profess, that the best thing the wearer of the flesh can do is to cast it off. That view makes the flesh and everything to do with it meaningless, except to those who are able to believe that life here is a designed trial. Undoubtedly, there is an humiliation in life, but it is not dependent altogether on corporeal conditions. It impresses itself most on all those who think, and on those who do not live for the hour, or the day, or the night. These latter are in the great majority, and that they are so is the greatest humiliation of all to the thoughtful. Undoubtedly, if we merely wish to continue on the scene to indulge our headstrong desires, we had better be gone at once; and if we only cherish a fondness for existence according to the good we derive from it, for many the pang we feel at parting with it will not be very severe. The religious tell us that life is but a vigilance, and that if we are not vigilant we are damned. Most of us, in these days, are content to have no philosophy at all, that being but a name for serious thought about the universal disaster of death. It is common knowledge that a full meal and a bottle of wine do wonders in restoring the rosy view of life, but this ready accommodation of ourselves to life is just the consenting to drift without a guiding star, a policy which appeals probably but to a few and is full of pitfalls for all. To hide from or try to ignore death is practically a distrust of all the facts and teachings of life. Death ever steals upon us in our smug security, and strips us bare of everything save the courage we have learned from philosophy and the faith that has been given us by religion. How many of us spend our hours shirking that fact?

Setting aside esoteric arguments, surely it is not wonderful that the contemplation and fear of death become more familiar to us as we approach nearer to it; it is nothing more than we begin by degrees to feel ourselves mortal. Perhaps religious considerations reconcile the mind to the change sooner than anything, by representing the spirit as fled to another sphere and leaving the body behind it. On the other hand, the clinging to life or reluctance to yield it may be an exaggerated effect of a highly civilized and artificial state of society. In old days, men plunged into all the vicissitudes and dangers of war with a certain recklessness and bold defiance; to them, religion had emphasized an implicit belief in a future life, rendering this present life of lesser value and embodying something beyond it for the imagination; so inspired, the rough soldier and chivalrous knight took leaps into the arms of futurity which the modern sceptic shrinks from, unless fortified

with high ethical standards the outcome of a new or wider knowledge both of man and the universe. Above all things, a life of action, danger and excitement moderates the dread of death. It not only gives us fortitude to bear pain, but teaches us at every step the precarious tenure on which we hold our present being. Our present fearlessness of death is probably because most men have set a just value on life, keeping it in a proper perspective with the nation's peril, and realizing that cowardice and pessimism will, on our death-beds, do no more for us than a good banking account or a fine suit of clothes. Every circumstance shouts to us to be brave, but that bravery is a rare and splendid form of genius. To attain it is the crown of existence, and finds its greatest encouragement in our present-day crisis, when men see the issue face to face, and give themselves gladly. *Prosit!*

A SYSTEM OF LATRINE CONSTRUCTION FOR DISPOSAL OF LATRINE CONTENTS BY INDIVIDUAL INCINERATION.

By Surgeon-General W. G. MACPHERSON, C.B., C.M.G., K.H.P.

Owing to the difficulties connected with the constant trenching of ground for latrine purposes in billeting areas, it became necessary to devise some method by which these difficulties could be satisfactorily overcome. Another consideration was the necessity of avoiding an extensive provision of ordnance receptacles for the construction of latrines on a removal system, and for diminishing as far as possible the danger of transmission of disease by the agency of flies.

The system which I finally determined to try during last summer was based on the shallow trench system, but substituting shallow trays for trenches, and individual incineration of excreta for individual covering of excreta with earth.

Empty biscuit tins or other suitable tins were cut in half to form two trays, as shown in the sketches, and an incinerator was made out of an empty cresol or paraffin drum, material which was generally thrown on to dump heaps or into refuse pits.

The general construction of a latrine with receptacles and incinerators of this nature is shown in the accompanying sketch plans.

The method of using a latrine of this construction is for the individual to use the latrine in the same manner as he uses a short shallow trench; and, immediately after use, to empty the contents of the tray receiving fæcal matter into the incinerator, and of the tray receiving the urine into a urine absorption pit.

The advantages of the system are:—

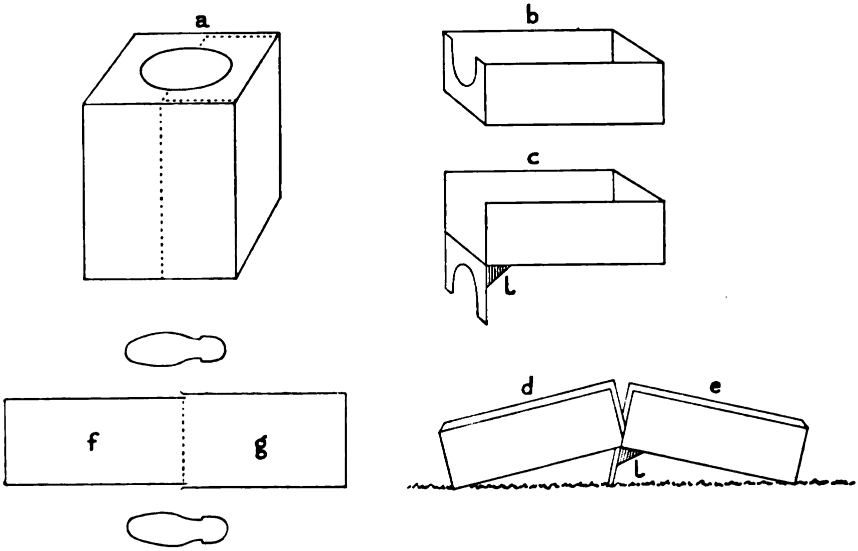
(1) That the necessary material is constructed out of what would otherwise be waste produce of the army, and therefore costs nothing.

(2) That each individual burns his own excreta and disposes of his own urine immediately after they are passed and without any other fuel.

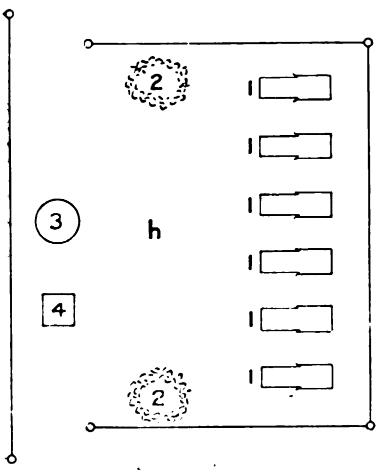
(3) That this process can go on continuously for an unlimited period of time on the same ground, and on an extremely small area of ground.

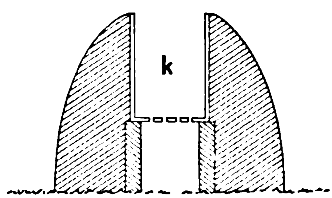
(4) That it can be carried out anywhere without taking into

SYSTEM OF LATRINES OF BISCUIT TINS FOR INCINERATION OF EXCRETA.



a = Biscuit tin cut along dotted lines.
b and c = The two trays thus formed.
d and e = Method of placing the trays on the ground, as latrine receptacles.
f and g = Plan of trays placed as latrine receptacles with position of feet a-straddle.
In tray "g" a bed of straw or other dry combustible material.
l = Triangular piece of tin soldered on to tray to strengthen foot piece.





k = An incinerator of empty paraffin drum with perforated bottom, standing on bricks, and built in with puddled clay.

h = Plan of a latrine screened enclosure.
1. Trays in position.
2. Heaps of straw or other material for placing in trays as at "g."
3. An incinerator as "k."
4. A urine absorption pit or receptacle.

consideration the nature of the soil on which the latrines are placed.

It differs therefore from the shallow trench system in so far that there is no process of extension of trench latrines continuously over a considerable area of ground, that questions of suitability of soil do not arise, that, as regards the disposal of excreta in a sanitary manner, there is no greater or more inconvenient work thrown upon the individual than in the shallow trench system, and that, while in both cases supervision is necessary, supervision is more easily carried out than in the shallow trench system.

The fact that flies appear to be completely absent from latrines of this nature is an important point, and one which I did not anticipate at the time this method was devised. It appeared to me, however, that, even if flies were attracted to latrines of this construction, there would be no opportunity for them to settle on excreta, because of the fact that the excreta were immediately incinerated.

The first trial of this system was entrusted to Lieutenant-Colonel L. P. Demetriadi, R.A.M.C. (T.F.), who with his staff and especially with his quartermaster, Lieutenant R. D. Matthews, R.A.M.C. (T.F.), displayed marked ingenuity and enthusiasm in adopting this system in his unit, at a time when much embarrassment was being felt in consequence of the constantly widening area of ground required for disposal of excreta on the shallow trench system.

It may be mentioned incidentally that the first experiment with such a system was almost certain to be a failure unless it was entrusted to a unit determined to make the underlying principle a success.

The result of the experiment has surpassed all expectations. It has now been on its trial for periods varying from one to four months in units where very large numbers have had to use these latrines; and in no case has it failed to meet all the requirements of a simple, immediate and efficacious means of disposing of excreta and urine.

The following extract from a report by Lieutenant-Colonel Demetriadi indicates the manner in which the system is being used by his unit, and the results of a prolonged experience and severe test:—

"We have made a thin concrete bed for the tins to stand upon. This bed is about a yard wide from back to front, and made to accommodate the number of tins required, but it is only necessary to have a space of twelve inches between each set.

"The method of usage is as follows: Pieces of newspaper are placed in the rear tins, and each man does this before he leaves the latrines. When he has finished, he empties the urine out of the front tin into the urine pit, and generally takes hold of the four corners of the newspaper and places it and the contents into the incinerator. He then places a fresh piece of paper in the tin ready for the next user. Newspaper is generally easy to procure, but if not, grass, hay, straw, or old rags will do equally well.

"Being a clearing station, our patients are constantly changing, and we find it necessary to explain the working of the system to them. We have also affixed a notice board, giving instructions. During the three months of working here, I have only known one occasion when a tin was not emptied. At night I find it advisable to have a lamp burning.

"The attention required by a sanitary orderly is not great, and does not by any means take up a man's whole time, but there are certain things to be done daily. Every morning the tins are washed out with a solution of cresol and water (though it is seldom that they get soiled in any way), and the outsides gone over with an old lather brush dipped in equal parts of cresol, oil and water. The concrete platform is swept, and sprinkled with a little cresol. The incinerators, which are seldom out, are seen to. If the fire is extinguished, a few hot ashes are brought from the cook-house, and a handful of small coal used; though the only time we have to use coal is perhaps after a pouring wet night. We have a small table in the compound on which stands a bowl containing a solution of cresol, and a clean towel, renewed daily, for use when a man soils his hands. The orderly also sees that newspapers are cut to the required size, and hung on a nail close at hand, and a box for latrine paper is kept supplied. We have canvas screens round the place, and a canvas top was erected over the tins.

"The advantages of the system are: (1) Practically no cost. (2) No pollution of ground. The same ground may be used for years. If I had not adopted this system I should have been compelled to remove my camp on account of shortage of space. (3) Entire absence of flies at the latrines. They are practically *nil* in my camp; first, because no fæcal matter is available, and secondly, flies do not like the heat and smoke from the incinerators.

"In conclusion, I wish to say I have used Surgeon-General Macpherson's system since the second week in July last with the most satisfactory results. *It has never once failed* and we have had as many as two thousand men here in one day. Many officers get

the impression that fæcal matter will not burn, and have said so to me, but if these instructions are carried out it will be found that it will burn extremely well and the little ash that remains is as fine as flour. I believe the system to be perfect and shall certainly adopt it in any camp or unit of which I may have command. It is cheap, clean and sanitary, and most appreciated by the men."

At two other units of the same size and importance as that of Lieut.-Colonel Demetriadi's which were established subsequently, the latrines have been constructed and used in the same manner and have given the same satisfaction.

I consider it essential, however, that any unit adopting this system should be determined to make it a success. If this attitude towards the system is adopted, success is assured and the system will be appreciated by all ranks, on account of its cleanliness and the small amount of trouble involved in disposing of latrine contents. Officers make use of individual incineration just as readily and willingly as others, and there is no difference between their latrines and those of non-commissioned officers and men in the units referred to.

One or two points of practical importance should be attended to:

(1) The incinerator should not, and need not, be larger than that provided by an empty ten-gallon or five-gallon paraffin drum. Good vent-holes must be made in it at the lower end; and it is best to surround it with clay or cement. Lieut.-Colonel Demetriadi's unit has constructed the incinerators according to the following description, which he has kindly given to me. (It should be understood that his description refers to the making, for the paraffin drum, a cement jacket, which, when set, is placed upright in position. The object of this jacket is to make the incinerator more lasting, as it was found that the clay puddled round the drum, as shown in the sketches, got cracked from the expansion of the drum by heat).

"The following articles are required: A barrel (minus bottom) or built-up outer frame, two old paraffin tins (minus bottom), cement, sand or shale, and pieces of scrap iron. The paraffin tins form a model for the cement jacket—which should be about 4 in. thick—and consists of one part cement to five parts sand. When finished the incinerator should stand about 30 in. high, but as a paraffin tin is only 17 in. high it is necessary to place one tin end to end with the other. At the point where the tins join, and about 12 in. from the ground, some pieces of iron should be passed through so as to form a grid for the tin to rest

upon when working. When the cement dries, the tins should be withdrawn, one up and the other down. It is now necessary to cut four oblong holes in the bottom of the cement jacket, front, back, and both sides, for draught purposes, the front hole being larger than the others so as to provide facilities for cleaning out. A bottomless paraffin tin is placed on the grid inside the jacket, but this must be cut from top to bottom and the diameter lessened slightly so that the heat will not cause the tin to expand to such a point that it will crack the cement jacket. Further, it is necessary when making the jacket to strengthen it with pieces of old iron or wood. When finished it should be whitewashed."

It should be added that the cement jacket should be as thick at the top as the bottom, and not as shown in the sketch of the incinerator with jacket of puddled clay. Also the paraffin drum should project for an inch or two above the top of the jacket, to prevent the edges of the latter being chipped when the men empty the contents of their trays into the incinerator.

One incinerator of this type, according to Lieutenant-Colonel Demetriadi, proved sufficient for the excreta of 1,000 men in twenty-four hours during a period when his unit had to deal with a large number of men. As a rule one of these incinerators should be placed alongside every ten sets of trays.

(2) The urine absorption pit should be constructed in the same way as urine absorption pits are now constructed in cantonments in India; namely, by filling a pit of 4 ft. to 6 ft. deep and 4 ft. square with stones or clinker and covering over the top with sods, except where an empty biscuit tin, with perforated bottom, is placed to act as a funnel into which the urine is emptied.

(3) Both urine pits and incinerators should be close together and close to the latrine trays, as shown in the sketches. Otherwise the men will not take the trouble to use them properly.

(4) The material which has proved most satisfactory for placing in the tray receiving the excreta is a sheet of newspaper, but dry grass or straw are equally useful. In some cases sawdust and chaff have been used, but are not so satisfactory, because fæcal matter is not so readily held up on a bed of either of these substances and is apt consequently to adhere to the trays.

(5) The advantage of having the trays placed together as shown in the sketch is that the back and front tray cannot be separated from one another, as is likely to be the case when two trays are placed together flat on the ground. The piece turned down to make the back tray rest obliquely on the ground should

be strengthened by soldering a triangular piece of tin to the angle. Otherwise this foot-piece is apt to bend forward in time. The edges of the trays should be turned over so as to take off their sharpness.

I am greatly indebted to Lieutenant-Colonel Demetriadi, Lieutenant Matthews, and the unit which the former commands, for the manner in which they have carried out all suggestions for establishing this latrine system, for many practical improvements, and for making the working of it so markedly successful that it is now becoming a well-known method of solving one of the most important problems of sanitation affecting an army in the field.

THE WORK OF FIELD AMBULANCES.

By Lieutenant-Colonel G. N. STEPHEN.
Royal Army Medical Corps.

In a note published in the *British Medical Journal* last winter it was indicated that while no adequate reason had yet presented itself for departing from accepted methods of conducting the training of field ambulance units, it was clear that the work of those then in process of formation or awaiting orders for the Front might not be quite what they at present expected.

At the time this statement was made there were already circumstances which justified it, and the accuracy of the forecast has been borne out in all particulars by the events of the past six months. That period has seen the arrival in France of troops who were then only in training, and it was being brought into touch with the work of certain field ambulances connected with these reinforcements that reminded the writer of what he had read in the Journal as to the diversity of offices that field ambulances as a whole might find themselves expected to fulfil.

The first of these units, which may be entitled A, was engaged in work in no wise resembling that which the term "field ambulance suggests." Instead of being more or less constantly on the move, and occupied in the collection of the wounded from the regimental aid posts, in doing emergency operations, and in passing on its cases to a casualty clearing station, it was an entirely stationary unit, filling a triple function of a much less exciting kind. Its vehicles had been parked for the time being and its personnel were divided up to run a clearing station for infectious cases; a bathing establishment, and an institution somewhat misleadingly termed a "convalescent hospital."

Its occupation, it is to be noted, was not in the least due to the fact that it was a newly arrived unit. The primary cause was that a need for the work in question had been created by the circumstances of the War and that the need was not directly anticipated by the ante bellum textbooks or assigned by Army regulations to any unit created *ad hoc*. The secondary cause was that A was free to undertake it. It was free to undertake it because, thanks to the siege-like character of the military operations then and now in progress, to the plenitude of motor ambulance convoys, and to the proximity of the casualty clearing stations, two of the three field

ambulances belonging to the division served by unit A fully sufficed for all the field work required.

The occupation of other field ambulances, which may be called B and C and D, also illustrated the same point, though not perhaps quite so completely.

B like A was a territorial unit but serving a different division, and also like A had at least three jobs in hand. It was running simultaneously a rest station, a laundry, an advanced dressing station, and a respirator factory. At the latter native labour was employed, but the whole work was in charge of an officer of unit B, with a file or two to assist him in its supervision.

The headquarters of units A and B were in a town of some size, but unit C was more or less under canvas. It was running a rest station and small bathing and laundry establishment, and was bivouacked around the farm buildings taken over for the purpose. C was a unit of long standing—it had, in fact, arrived in France with the first detachment of the expeditionary force—but just as in the case of units A and B, its services in its usual capacity were not required for the moment by the division to which it belonged.

As for D, this letter relates not to a single unit but to all three field ambulances of one particular division. On paper they preserved their independence, but otherwise they had practically conglomerated. Their headquarters were in a village of some size, and between them they were running a large rest camp, which included a bathing station, a "convalescent hospital"—established in a permanent building of some size—and two dressing stations, one in an advanced, the other in an intermediate position. Their various officers were taking turns of duty at regular intervals in connexion with all the different enterprises conjointly carried on, and in this way all shared fairly whatever was to be had in the way of dull work or exciting work, risky posts or safe posts, soft jobs or hard jobs.

The same idea of sharing all forms of work also underlay, I understood, the arrangements of the divisions to which units A, B and C belonged. At intervals the different field ambulances of each of the divisions concerned were to exchange position and occupation. Whether the plan was ever put into effect I do not know, for the next time I was in the same area I found that units A, B and C, together with the divisions to which they belonged, had all moved to a distant part of the line, and the work they had been doing was now in other hands.

The occupations described do not, as a whole, sound perhaps

particularly interesting, or likely to appeal to men so mentally and physically constituted as to have been led—as far as concerns the officers of units A and B—to select a field ambulance unit when joining the Territorial Force. Nevertheless there did not seem to be any disposition to grumble at their existing employment. They did not expect to be engaged for any very long period, and meantime they were anything but mere machines. The work demanded not only industry and energy, but also ingenuity and organizing power. In addition its utility was obvious.

Rest Camps and Bath-houses.

It will have been observed that in the case of only one of the units mentioned in the foregoing note do the duties described include no field work whatever. They were, in short, not exceptionally situated units, but engaged in a fashion which made them as a whole a very fair sample of their class. The needs of all divisions in the matter of baths, cleansing operations, rest camps, and their like are much the same, and unless they are met by some arrangement available to a large number of divisions it is to its A.D.M.S. and the field ambulances under his command that a division looks for assistance in the matter. Obviously rest camp and convalescent work is medical, and baths and clean underclothes are such powerful adjuncts to directly medical measures for keeping the men in good health, that all A.D.M.S.'s, I believe, regard it as part of their ordinary duty to see that they are somehow or other made available.

But of course, they always bear in mind the possibility of a general advance, or of a heavy local offensive or defensive operation, suddenly and greatly increasing the need for field work, and hence take care that it should be possible instantly to release their personnel of their field ambulance units for this purpose. Given the occasion, rest camps and convalescent hospitals must be temporarily evacuated, baths and washhouses closed, unless the D.D.M.S. of the Army Corps involved prefers to fill the vacated posts by drawing M.O.'s temporarily from some other division, or by asking the D.M.S. of the Army to which his corps belongs to get up additional medical officers from the base. But in this matter there can rarely be any great difficulty. Divisions which are heavily engaged have no time for baths, and heavy fighting seems itself a sovereign remedy for most of the ills that help to fill the rest camps and convalescent hospitals. A glance at the

sickness and casualty chart of almost any division will show that as the red line rises the black line usually falls.

The infectious case clearing station mentioned at the beginning of the previous note was not specially for the benefit of the division to which belonged the field ambulance in charge of it. Like an ordinary casualty clearing station it was an army head-quarters unit and part of the general machinery—some prearranged, some improvised to meet new needs—for keeping down the wastage due to zymotic disorders. All cases of illness, diagnosed at a regimental aid post or an advanced dressing station, or elsewhere in the area, as being probably of an infectious order, were sent there for final diagnosis and disposal instead of to the nearest casualty clearing station. The necessary accommodation was provided by some modern farm buildings and a number of marquees, and it allowed of six different classes of cases being separately isolated. The patients remained as a rule only a very few days. The diagnosis assured—with the help of a mobile laboratory if need be—the patient was sent on to a base either in the isolation coach of a hospital train or by a special ambulance, usually the latter.

The scope and status of the other enterprises varied a little. The rest camps and convalescent hospitals confined their work to men of their own respective divisions, but one of the bathing establishments seemed prepared for work on a still larger scale.

The means at the disposal of these bathing establishments were in some cases primitive, but their scheme of work was identical and they all attained their primary aim. This was to provide each entrant with a bath of hot water and plenty of soap, and to substitute for the underclothing that he was then wearing a set which was both clean and in good repair.

At the larger establishment that has been mentioned they went a good deal further that this; they turned a man out not only completely re-equipped in the matter of under-garments, but attended to his external clothing as well. As it had been dealing on these lines with an average of just under one thousand men a day for many successive weeks, it is natural to surmise that its arrangements were elaborate and its premises especially suited to the end in view.

This was in fact the case. The work was done in a very large building, which being in peace times a linen weaving and dyeing factory, possessed fitments readily adaptable to the requirements of a combined bathing, clothes washing and clothes repairing establishment on a very extensive scale—boilers, hot-water pipes, drying

rooms and racks, huge vats, in each of which half-a-dozen men could bathe simultaneously.

The men, as they arrived, commonly in companies, made their outer clothing into bundles (all except their boots), which were then removed to a sterilizer. They then moved in sections into the vat room, where they stripped, throwing each separate garment into a separate receptacle—one for vests, one for pants, one for socks—then took their baths and dried themselves, the whole process being timed and lasting a given number of minutes. The re-dressing arrangements, which included the issue of fresh underclothing in good condition, was conducted at the same time in a separate hall. Meantime, and all day long, laundry and repairing work went on in different halls, all the various appliances required in the way of washing, wringing and sewing machines, being provided, and about one hundred women being employed to work them.

The term "convalescent hospital," which has been used in speaking of the work of two of the units mentioned in the previous note, is not strictly official. The institutions to which it is applied were two large well-fitted buildings which might be regarded as the tent sections of the ambulances concerned. Their accommodation was more elaborate, but their work was identical with that of the rest stations or camps. The patients were for the most part men suffering from slight ailments or trifling injuries; tired men, footsore men; men with slight bronchial attacks, stomachic troubles, passing skin complaints; men undergoing anti-typhoid inoculation; men suffering from pyrexia not deemed to be premonitory of serious disorder. If any patient failed to fulfil expectations by getting quite well within a few days, or if he developed symptoms suggesting the probability of prolonged illness he could always be sent to a base via a casualty clearing station, and meantime he was receiving all the attention he required.

These rest stations, in short, fulfilled a double purpose. They supplied a means (1) of bringing a possibly serious case under treatment when in an incipient stage; (2) of conforming to an accepted axiom of military medicine, namely, that cases likely to be fit to return to duty within a limited time should not be removed for treatment to a greater distance from their units than is inevitable.

Finally, it should be mentioned that it is not always under the title of rest station or convalescent hospital that work of this order is carried on. A good deal depends on local circumstances,

including the proximity of the field ambulances to one another and to a casualty clearing, the character of the accommodation that a field ambulance can secure, the nature of the ground just behind the actual fighting line, and the distance between the opposing trenches.

In some cases ambulances may be so situated that they can carry on both rest station and ordinary tent section work simultaneously and in the same building. In other words, they can provide both for the seriously wounded and sick men, who after receiving a certain amount of attention will be sent on to a casualty clearing station, and for the light cases whose treatment will begin and end at the ambulance itself.

As for the field work of ambulances, its description or discussion was not one of the objects of this note. Since, however, so much stress has been laid herein on what may be described as the civil or institutional side of field ambulance life, it may be well also to accentuate the fact that it is for youngish, or at all events hardy men, that ambulance duty is best fitted. Taken as a whole, it involves a rough and comfortless life, combined with a considerable spice of danger.

IDENTIFICATION OF THE MENINGOCOCCUS.

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In a previous paper, published in this Journal for May, 1915, the result was described of some preliminary experiments made for the purpose of ascertaining the extent to which the absorption of agglutinin test can be applied practically for the purpose of identifying the micro-organism of the present outbreak of cerebrospinal fever. Anti-meningococcus sera on the market having proved unsatisfactory for this purpose, a suspension of a culture of meningococcus, recently isolated from the cerebrospinal fluid of an acute case, was injected intravenously into a young rabbit, and a specific agglutinating serum thus prepared. Having obtained in this way a serum giving good macroscopic agglutination, meningococci isolated from the cerebrospinal fluid of three further cases of meningitis were then tested against this serum and found to agglutinate practically as well as the homologous strain. On making absorption tests, it was found that three of these meningococci absorbed the homologous agglutinin; the fourth failed to do so in the experiment described, but as this coccus failed at the same time to absorb the agglutinin for itself the result was inconclusive. It may be added that this coccus has since been found to absorb the homologous agglutinin in question.

Application was now made of this serum for the purpose of determining the behaviour towards it of three Gram-negative cocci isolated from the nasopharynx of contacts, and of cases of doubtful illness suspected of being anomalous forms of cerebrospinal fever. The cocci in question were indistinguishable from the meningococcus in the morphological, staining, cultural, and fermentative properties examined. One of them altogether failed to agglutinate with the serum. The other two agglutinated to a certain extent with it, but did not absorb the specific meningococcus agglutinin. None of these three nasopharyngeal cocci, therefore, could be identified with the meningococcus against which the serum had been prepared.

The inference drawn from these preliminary observations was that the absorption method promised to have a distinct value in certain cases for the purpose of differentiating the meningococcus from micrococci closely resembling it in cultural characters, but

devoid of the same pathogenic significance. It was considered, however, that as there are possibly, and even probably, several distinct races of meningococcus concerned in the present outbreak, the value and limits of the method in this connection could not be stated until a far larger number of meningococci from the cerebrospinal fluid of cases had been collected and examined in the same way.

During the interval that has elapsed since the preliminary experiments referred to, it has been our good fortune to be able to obtain a considerable number of cultures of meningococci all isolated in the first place from the cerebrospinal fluid of cases during the present outbreak. We are greatly indebted to Dr. Arkwright, of the Lister Institute; Captain Gaskell, of the 1st Eastern General Hospital, Cambridge; Dr. O'Brien, of Brockwell Hall; Lieutenant Macmahon, of York; Lieutenant Compton, of Weymouth; Dr. Barrington White, of Nottingham; Dr. Claridge, of Norwich; and others who have placed cultures at our disposal for this purpose. As a result, we are now able to report on thirty-two specimens of meningococcus, all of which came in the first instance from the cerebrospinal fluid of cases during the recent outbreak. In addition, we have been able to examine in the same way nine Gram-negative cocci, indistinguishable from the meningococcus in cultural and fermentative characters, isolated from the nasopharynx either of contacts or of cases of illness suspected to be instances of cerebrospinal fever, in which symptoms of meningitis were absent or suppressed.

METHOD.

Before proceeding to state the result of this further investigation, we will describe as briefly as possible the method which we have been using. In order that our results should be comparable, and in order that they should be easily checked by others, we have tried to make our tests on as simple and standard a basis as possible. Our procedure has been as follows:—

(1) *Preparation of a Suspension of the Coccus.*—In the first place the Gram-negative coccus is plated out on a series of legumin-agar plates and a subculture made from a single colony on to a slope. On the following day this slope is subcultured into a tube of trypsin broth (Douglas) neutral to phenolphthalein, to which about one-tenth of its volume of sterile serum or ascitic fluid has been added. This ascites broth culture has the great advantage that the meningococcus will live in it for three weeks or more.

From the legumin-agar slope culture we now proceed to inoculate six or eight Petri dishes of the same medium. These plates are spread in the usual way with a platinum or iron wire, or with a piece of capillary glass tubing bent to a right angle. After twenty-four hours' incubation these plates show, as a rule, a profuse confluent growth of the coccus. Five cubic centimetres of sterile saline is now poured into each plate, and the growth raked off the agar and distributed in the saline by means of a bent wire. If the growth sticks to the agar, it is advisable to rub it off with a small swab. The suspension is now poured off into test-tubes, a separate tube being used for each plate. Film preparations are then made from the contents of each tube, stained with Gram, and examined microscopically. Any tubes showing contaminations are at once rejected, the rest are mixed together and heated for half an hour to 65° C. to kill the coccus and to inactivate its autolysin, as recommended by Raymond Koch, applying Flexner's work on meningococcus autolysin. Heating in this way also appears to help the coccus to emulsify.

(2) *Standardization of the Suspension.*—The heated suspension of the coccus is standardized in the following way:—

By means of a pipette holding 0·1 c.c., this amount of the suspension is transferred to a special glass test-tube kept for the purpose. Then with a 5 c.c. pipette graduated in tenths of a cubic centimetre, tap-water is run in until the suspension is so dilute that it is only just turbid to the naked eye when compared with a control tube of tap-water *per se*. This end-point is taken to represent a content of 100 million per cubic centimetre. The volume of the suspension is then measured and a simple calculation gives the total number of cocci contained by it. For example, 0·1 c.c. of the suspension requires to be diluted with 5 c.c. of water to reach the end-point. It contained, therefore, 500 million cocci in 0·1 c.c., or 5,000 million per cubic centimetre.

Its strength having been in this way determined, the suspension is diluted with saline so as to make its value approximately 2,000 million per cubic centimetre, and 0·5 per cent of phenol is added. This standard phenolated suspension of the coccus is kept in a glass-stoppered bottle and placed in the cold storage. It is used for all agglutination and absorption tests, and also for injecting rabbits.

(3) *Preparation of Agglutinating Serum.*—We can endorse the statement of Elser and Huntoon that young rabbits are to be preferred for this purpose. Our best sera have been obtained from

rabbits weighing between 1,000 and 1,500 grammes. The material with which they are injected is the standard suspension already described, and all of our injections have been intravenous. As we could not wait for a month or longer for an agglutinating serum, we had to use an intensive method of some kind. We began by using Fornet and Müller's method of giving increasing doses at twenty-four hours intervals for three days in succession. We have also used the following method which occasionally gives a serum with a titre as high even as 1 in 800 within ten days. The rabbit is given ½ c.c. of the suspension (1,000 million cocci) and then forty-eight hours later it receives three doses of 1,000 million at hourly intervals. This method, which we call our "saturation" method, was suggested by some experiments made by one of us in conjunction with T. J. Horder some years ago. We may add that the relative merits of various modes of dosage for the purpose of producing an agglutinating serum in the shortest time is under investigation by Captain Hine.

(4) *Absorption Tests.*—It is very necessary in making an investigation of this kind to do all the tests in exactly the same way, and we had variable results until we standardized our mode of doing absorption tests. At first we added a number of loopfuls of living growth to a known dilution of serum, placed the tube at 37° C. or at 55° C., and centrifuged out the cocci after two or three hours. The results were uneven, and we then made the following comparative experiment. Five cocci were tested against the same serum; in the first series the serum was diluted directly with the standard suspension; in the second, the serum was diluted to the same extent but half with saline, and then half with suspension. The tubes were allowed to stand overnight at 37° C., then centrifuged next morning and titrated against the coccus of test and the coccus homologous to the serum respectively, a control being done at the same time against the unsaturated serum. The result of this experiment was to show that the latter method, i.e., dilution half with saline and half with suspension, gave the best results; and accordingly we adopted it for routine use.

Our procedure in carrying out the absorption test is briefly as follows:—

Say that the serum has a titre of 1 in 800 against the standard emulsion of the homologous coccus in twenty-four hours at 55° C. We propose to test it in dilutions of 1 in 100, 1 in 200, 1 in 400, and 1 in 800, before and after saturation with a given coccus in order to see if this coccus does or does not absorb the homologous

agglutinin. We make first of all a sufficient quantity of a 1 in 50 dilution of the serum in saline and put this into a test-tube in the rack used for absorptions. This is our specimen of the serum before saturation. We next put out a sterile centrifuge tube for each coccus that we propose to test, including one for the homologous coccus (control positive), and another for a heterologous coccus (control negative).

Into each of these tubes we put 2·5 c.c. of a 1 in 25 dilution of the serum of test. Next we add an equal amount of the standard suspension of each coccus in turn. We then place these tubes in the incubator at 37° C. overnight. Next morning we note those that have agglutinated and centrifuge all of the tubes for half an hour. The serum before saturation is then titrated against the coccus of test, and the serum after saturation is titrated against the coccus homologous to the serum and also against the test coccus. In addition, a control tube is put up of each coccus against normal rabbits' serum. Should the result of an absorption test made in this way be at all doubtful, we then saturate the same serum over again and proceed as before. The first saturation sometimes clears off "agglutinoids" very nicely from serum.

Up to the present we have done all our agglutinations at 55° C. and have read them off after twenty-four hours exposure to this temperature. We use small test-tubes three inches long by half an inch wide plugged with cotton-wool. The tubes are arranged in small racks designed for the purpose by Captain Hine. These racks hold twelve tubes abreast and have strips of xylonite nailed in front of each row for the purpose of labelling. Having arranged the tubes in the rack for the experiment, we first put $\frac{1}{2}$ c.c. of the required dilution of serum in each of the tubes, and then add to the tubes of each group $\frac{1}{2}$ c.c. of the standard suspension of the necessary coccus. In adding the suspension, it is advisable to add first of all the suspension of the coccus homologous to the serum of test to the batch of tubes devoted to it, and then to replace the plugs, or to cover these tubes over. In this way the possibility of adding suspension to the wrong tubes is avoided. A pipette graduated in $\frac{1}{2}$ c.c.'s and worked by a rubber teat is useful. When judging the result we find it advisable to use in some cases a small hand-lens giving about eight diameters. If there is any doubt about the agglutination, we give the tube a shake and look for flocculi. If these are absent we enter the result as negative.

The arrangement of the tubes is seen from the following experiment:—

No.	Coccus	Normal rabbit serum (control)	Serum Jones (Rabbit 19)									
			Before saturation				After saturation					
			v. Test coccus				v. Jones coccus				v. Test coccus	
		1 : 50	1 : 100	1 : 200	1 : 300	1 : 400	1 : 100	1 : 200	1 : 300	1 : 400	1 : 100	1 : 200
1	Jones ..	–	+	+	+	+	–	–	–	–	–	–
2	Smith ..	–	–	–	–	–	+	+	+	+	–	–
3	Robinson	–	+	(+)	–	–	+	+	+	+	–	–
4	Jenkins ..	–	+	+	–	–	–	–	–	–	–	–

+ = agglutination well marked ; (+) = slight agglutination.

In this experiment, Jones, the control homologous coccus, has by saturation absorbed its own agglutinin in all of the four dilutions. Smith, the control heterologous coccus, neither agglutinates with Jones serum nor absorbs the Jones agglutinin. Robinson agglutinates somewhat, but does not absorb. Jenkins agglutinates to the same degree as Robinson, and absorbs Jones agglutinin. Clearly, then, of the above cocci Jones and Jenkins alone combine with the specific agglutinin in this serum and remove it, and the Robinson coccus was only affected by a group agglutinin.

Results.

(1) *Meningococci isolated from the Cerebrospinal Fluid of Cases during the recent Outbreak.*—Specimens of these cocci from thirty-two different cases have been examined up to date. So far as morphological, staining, and cultural characters go, they all appear to be undoubted meningococci. All except three failed to grow on legumin agar at 23° C., and all except two fermented glucose in three to four days at 37° C. The two cocci negative to glucose were in all other respects typical meningococci, and one of them has been found on repeated trials fitfully to produce some feeble fermentation of glucose. None of these thirty-two meningococci fermented saccharose.

In addition, a culture of the parameningococcus of Dopter, kindly sent to us by Dr. Louis Martin, of the Pasteur Institute, Paris, has been investigated in the same way. Like the majority of the above cocci this parameningococcus failed to grow on legumin-agar at 23° C., and fermented glucose, but left saccharose unchanged.

Procedure has been as follows: In the first place a suspension was prepared of each coccus and this was standardized and phenolated in the manner described. Then one of these suspensions was injected intravenously into a young rabbit and an agglutinating serum prepared. Each of the meningococci was now titrated against this serum, and its capacity of combining with the homologous agglutinin determined.

TABLE I.—CEREBROSPINAL FLUID MENINGOCOCCI *v.* SERUM OF RABBIT PREPARED AGAINST MENINGOCOCCUS NO. 1.

	Serum M. 1.									
	Before saturation				After saturation					
	v. Test coccus				*v.* M. 1 coccus				*v.* Test coccus	
Dilution	100	200	400	800	100	200	400	800	100	200
Meningococcus 1	+	+	+	+	–	–	–	–	–	–
2	+	+	+	(+)	–	–	–	–	–	–
3	+	+	+	–	–	–	–	–	–	–
4	+	+	+	(+)	–	–	–	–	–	–
5	+	+	+	+	–	–	–	–	–	–
6	+	+	+	–	+	–	–	–	–	–
7	+	+	+	–	(+)	–	–	–	–	..
8	+	+	+	–	–	–	–	–	–	..
9	+	+	+	(+)	–	–	–	–	–	..
10	+	+	(+)	–	+	–	–	–	–	..
11	+	+	(+)	–	+	–	–	–	–	..
12	+	+	–	–	(+)	–	–	–	+	–
13	+	+	–	–	+	–	–	–	+	–
14	+	+	+	+	(+)	–	–	–	–	..
15	+	+	+	+	–	–	–	–	–	..
16	+	+	+	(+)	–	–	–	–	–	..
17	+	+	+	+	–	–	–	–	–	..
18	+	+	+	(+)	–	–	–	–	–	..
19	+	+	+	–	–	–	–	–	–	..
20	–	–	–	–	+	+	+	+	–	..
21	–	–	–	–	+	+	+	+	–	..
22	–	–	–	–	+	+	+	+	–	..
23	–	–	–	–	+	+	+	+	–	..
24	+	(+)	–	–	+	+	+	(+)	–	..
25	–	–	–	–	+	+	+	+	–	..
26	(+)	–	–	–	+	+	+	+	–	..
27	–	–	–	–	+	+	+	–	–	..
28	–	–	–	–	+	+	+	+	–	..
29	+	–	–	–	+	+	+	+	–	..
30	–	–	–	–	+	+	(+)	(+)	–	..
31	–	–	–	–	+	+	+	+	–	..
32	–	–	–	–	+	+	+	+	–	..
Parameningococcus	–	–	–	–	+	+	+	+	–	..

The results are seen in Table I. The readings recorded in this table show that the serum in question divided the meningococci

into two distinct groups. The first nineteen specimens both agglutinated with the serum and absorbed the specific agglutinin. The last fourteen cocci, on the other hand (specimens 20 to 33), for the most part failed to agglutinate with the serum, and they all failed to absorb the specific agglutinin.

TABLE II.—Cerebrospinal Fluid Meningococci *v.* Serum prepared against Meningococcus No. 20.

	Serum M. 20									
	Before saturation				After saturation					
	v. Test coccus				*v.* M. 20 coccus				*v.* Test coccus	
Dilution	100	200	300	400	100	200	300	400	100	200
Meningococcus 1	−	−	−	−	+	+	+	(+)	−	..
2	+	(+)	−	−	+	+	+	(+)	−	..
3	+	−	−	−	+	+	+	(+)	−	..
4	(+)	−	−	−	+	+	+	(+)	−	..
5	+	−	−	−	+	+	+	(+)	(+)	−
6	+	−	−	−	+	+	+	(+)	(+)	−
7	−	−	−	−	+	+	+	(+)	(+)	−
8	−	−	−	−	+	+	+	(+)	−	..
9	−	−	−	−	+	+	+	(+)	−	..
10	−	−	−	−	+	+	+	(+)	−	..
11	(+)	−	−	−	+	+	+	(+)	−	..
12	+	−	−	−	+	+	+	(+)	+	−
13	+	+	−	−	+	+	+	−	−	..
14	(+)	−	−	−	+	+	+	(+)	(+)	..
15	(+)	−	−	−	+	+	+	(+)	−	..
16	(+)	−	−	−	+	+	+	−	−	..
17	−	−	−	−	+	+	+	(+)	−	..
18	−	−	−	−	+	+	+	(+)	−	..
19	−	−	−	−	+	+	+	(+)	−	..
20	+	+	+	+	+	−	−	−	+	−
21	+	+	−	−	+	−	−	−	+	−
22	+	+	+	+	+	−	−	−	+	−
23	+	+	+	+	+	−	−	−	+	−
24	+	+	+	−	+	−	−	−	+	−
25	+	+	+	(+)	+	−	−	−	+	−
26	+	+	+	−	+	−	−	−	+	−
27	+	(+)	−	−	(+)	−	−	−	−	−
28	(+)	−	−	−	+	+	+	−	−	..
29	−	−	−	−	+	+	+	−	−	..
30	−	−	−	−	+	+	+	−	−	..
31	(+)	−	−	−	+	+	+	(+)	−	..
32	−	−	−	−	+	+	+	−	−	..
Parameningococcus	+	−	−	−	+	+	+	−	−	..

The next step was to prepare a rabbit against the first of these fourteen heterologous cocci and to test the whole of the cocci in the same way with this serum. The result is shown in Table II.

It is seen that the first nineteen meningococci showed a comparatively minor degree of agglutination with this serum, and that they all failed to combine with the agglutinin of the meningococcus (No. 20) against which the rabbit had been prepared.

TABLE III.—CEREBROSPINAL FLUID MENINGOCOCCI *v.* SERUM PREPARED AGAINST MENINGOCOCCUS NO. 28.

	Serum M. 28									
	Before saturation				After saturation					
	v. Test coccus				*v.* M. 28 coccus				*v.* Test coccus	
Dilutiou	100	200	300	400	100	200	300	400	100	200
Meningococcus 1	+	+	+	–	+	+	(+)	–	–	..
2	+	+	+	(+)	+	+	(+)	–	–	..
3	+	–	–	–	+	+	–	–	–	..
4	+	+	+	+	+	+	(+)	–	(+)	–
5	+	+	(+)	–	+	+	(+)	–	–	..
6	+	+	+	–	+	+	(+)	–	–	..
7	+	+	+	–	+	+	(+)	–	–	..
8	+	+	+	–	+	–	–	–	(+)	–
9	+	+	+	–	+	+	+	–	–	..
10	+	+	+	(+)	+	+	+	–	–	..
11	+	+	+	(+)	+	+	(+)	–	–	..
12	+	+	+	–	+	+	+	–	–	..
13	+	–	–	–	+	+	(+)	–	–	..
14	+	+	–	–	+	+	+	–	–	..
15	+	+	(+)	–	+	+	+	(+)	(+)	–
16	+	+	(+)	–	+	+	(+)	–	–	..
17	+	+	–	–	+	+	+	–	–	..
18	–	–	–	–	+	+	+	(+)	–	..
19	(+)	–	–	–	+	+	(+)	–	–	..
20	–	–	–	–	+	+	+	(+)	–	..
21	–	–	–	–	+	+	+	(+)	–	..
22	(+)	–	–	–	+	+	+	–	–	..
23	–	–	–	–	+	+	+	(+)	–	..
24	–	–	–	–	+	+	+	–	–	..
25	(+)	–	–	–	+	+	+	–	–	..
26	–	–	–	–	+	+	+	(+)	–	..
27	–	–	–	–	+	+	+	(+)	–	..
28	+	+	+	(+)	–	–	–	–	–	..
29	+	+	+	+	–	–	–	–	–	..
30	+	+	+	+	–	–	–	–	–	..
31	(+)	–	–	–	(+)	–	–	–	–	..
32	–	–	–	–	+	+	+	(+)	–	..
Parameningo-coccus	+	–	–	–	+	+	+	–	–	..

On the other hand, no fewer than eight of the fourteen meningococci negative to the first serum both agglutinated and absorbed with the present serum.

The next step was to prepare another rabbit against the first of the remaining six cocci still unaccounted for, and to examine the whole of the meningococci in the same way against this serum. The results are shown in Table III. The readings given with this third serum are distinctly interesting. In the first place, no fewer than four of the six meningococci not yet accounted for combined with the specific agglutinin of this third serum. Moreover, one of these cocci absorbed the agglutinin although it agglutinated with the serum to a comparatively minor degree.

The second point of interest with regard to this serum is that several of the cocci of class 1 agglutinated quite well with it, and one of them (No. 8) that had absorbed the specific agglutinin of No. 1 serum absorbed also a certain amount of the specific agglutinin of the present serum.

These three sera, therefore, accounted for no fewer than thirty-one of the thirty-two meningococci under investigation. The last meningococcus, viz., No. 32, is so far unique. It came from the cerebrospinal fluid of a very protracted case of meningitis at York. A rabbit has been prepared against this coccus, and specimens of all the other groups put up against its serum, but they neither agglutinate with the serum nor do they combine with the agglutinin of coccus No. 32.

Coccus No. 33, the parameningococcus of Dopter, which was also examined in these tests, is apparently distinct from all the four groups into which these thirty-two specimens of meningococci from the cerebrospinal fluid of cases in the present outbreak are resolved by the absorption of the agglutinin test.

The investigation is being continued, and meningococci are being examined in the same way as they come to hand.

(2) *Meningococcus-like Cocci from the Nasopharynx.*—The immediate object for which this investigation in the first instance was undertaken was to obtain a specific serum whereby the micro-organism of the present outbreak could be more readily and accurately identified in cultures from the nasopharynx.

When these sera were being prepared we had in stock nine nasopharyngeal cocci, all of which were practically indistinguishable from the meningococcus in morphological, cultural staining and fermentative characters. Seven of these cocci had been isolated from contacts, and two from cases of illness suspected of being instances of cerebrospinal fever without meningitis.

These nasopharyngeal cocci have been tested with the sera prepared against the four types of meningococcus referred to above.

and also with a serum prepared in the same way against the parameningococcus.

As a result we have found that five of them agglutinate with the serum prepared against type 2 meningococcus, and also combine with the specific agglutinin of that strain. The reverse experiment was then made, and a rabbit prepared against one of these nasopharyngeal cocci (D. 24), that had been identified with the second type of meningococcus. All of the thirty-three cerebrospinal fluid cocci were then put up against this (D. 24) serum, with the result that the same eight meningococci were selected by it as had been picked out by the original type 2 meningococcus serum. This result seems to us to establish the identity of these five nasopharyngeal cocci with the second strain of meningococcus beyond all reasonable doubt.

Only four of these five cocci thus identified with the meningococcus came from contacts. The fifth came from the nasopharynx of a case of pyrexia of unknown origin invalided home from the Front for fever. No meningeal symptoms occurred in this case. We have to thank Dr. Frank Taylor, Pathologist to the Queen Alexandra Military Hospital, for kindly giving us this culture.

It was puzzling to us to find that we had no specimen of type 1 meningococcus among our nasopharyngeal cocci. On reflection, however, it occurred to us that these nasopharyngeal cocci which we had in culture had all been isolated at a more recent stage of the outbreak than the cerebrospinal fluid cocci which we had been testing, and therefore we thought that possibly had we still possessed nasopharyngeal cultures from contacts in an earlier stage of the outbreak we might have found among them type 1 of the meningococcus. Confirmation of this view has since been afforded in a remarkable way, for having recently been asked to examine a carrier who had been in isolation for over six months, and had last been in contact with a case of cerebrospinal fever in the earlier stage of the outbreak, we obtained from his nasopharynx a Gram-negative coccus indistinguishable in cultural and fermentative characters from the meningococcus. On trial against our five sera this coccus was found to agglutinate and absorb with one only of them, namely, with the serum which had been prepared against type 1 of meningococcus.

The results given by these ten nasopharyngeal cocci with sera prepared against types 1 and 2 meningococci respectively are shown in Tables IV and V.

TABLE IV.—Nasopharyngeal Cocci *v.* Serum prepared against Meningococcus No. 1.

		Serum M. 1										
		Before saturation				After saturation						
		v. Test coccus				*v.* M. 1 coccus				*v.* Test coccus		
		200	400	600	800	200	400	600	800	200	400	
1	M. 1 ..	+	+	+	+	–	–	–	–	–	–	Control positive.
2	M. 20 ..	–	–	–	–	+	+	+	+	–	–	Control negative.
3	D. 24 ..	–	–	–	–	+	+	+	+	–	–	
4	D. 32 ..	–	–	–	–	+	+	+	+	–	–	
5	D. 35 ..	+	(+)	–	–	+	+	+	+	–	–	
6	D. 40 ..	–	–	–	–	+	+	+	+	–	–	
7	H. 6 ..	–	–	–	–	+	+	+	+	–	–	
8	B. 12 ..	–	–	–	–	+	+	+	+	–	–	
9	S. ..	–	–	–	–	+	+	+	+	–	–	
10	A. ..	+	+	–	–	+	+	+	+	–	–	
11	B. 1 ..	+	+	–	–	+	+	+	+	–	–	
12	B. 2 ..	+	+	+	–	–	–	–	–	–	–	

TABLE V.—Nasopharyngeal Cocci *v.* Serum prepared against Meningococcus No. 20.

		Serum M. 20										
		Before saturation				After saturation						
		v. Test coccus				*v.* M. 20 coccus				*v.* Test coccus		
		100	200	300	400	100	200	300	400	100	200	
1	M. 1 ..	–	–	–	–	+	+	+	+	–	–	Control negative.
2	M. 20 ..	+	+	+	+	+	–	–	–	–	–	Control positive.
3	D. 24 ..	+	+	+	(+)	–	–	–	–	–	–	
4	D. 32 ..	+	+	+	+	+	–	–	–	–	–	
5	D. 35 ..	+	+	+	+	(+)	–	–	–	–	–	
6	D. 40 ..	–	–	–	–	+	+	+	(+)	–	–	
7	H. 6 ..	+	+	(+)	–	–	–	–	–	–	–	
8	B. 12 ..	–	–	–	–	+	+	+	(+)	–	–	
9	S. ..	+	+	+	–	–	–	–	–	–	–	
10	A. ..	–	–	–	–	+	+	+	+	–	–	
11	B. 1 ..	–	–	–	–	+	+	+	+	–	–	
12	B. 2 ..	–	–	–	–	+	+	+	+	–	–	

Summary.

(1) Specimens of meningococcus isolated from the cerebrospinal fluid of thirty-two cases during the present outbreak were resolved by the absorption of agglutinin test into four groups. Of the meningococci in question 19 belong to Group I; 8 to Group II; 4 to Group III; and 1 to Group IV. So far, only one specimen of Group IV has been obtained.

(2) One specimen appeared to absorb the specific agglutinin of two groups, i.e., to be amphoteric.

(3) All of these thirty-two meningococci are distinct from the parameningococcus of Dopter.

(4) Of nine specimens of Gram-negative cocci isolated from the nasopharynx of contacts and suspected cases, and closely resembling the meningococcus in morphological, cultural, staining, and fermentative characters, five have been found by the absorption of agglutinin test to be identical with Group II of the cerebrospinal fluid meningococci. A further specimen recently isolated from the nasopharynx of a chronic carrier has been identified in the same way with Group I of these same meningococci obtained from the cerebrospinal fluid of cases in the present outbreak.

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PRELIMINARY NOTE ON THE RAPID PREPARATION OF HIGH-TITRE AGGLUTINATING SERUM FOR THE MENINGOCOCCUS.

By Captain T. G. M. HINE.
Royal Army Medical Corps.

In the course of some recent experiments made in the Central Laboratory for Cerebrospinal Fever, for the purpose of obtaining, with the smallest possible delay, serum with a reasonably high content of agglutinin for the meningococcus, it was found that there was no sufficient certainty as to the results. The statement of Elser and Huntoon that young rabbits are preferable to full-grown ones for this purpose was confirmed. The intensive method of Fornet and Müller, by which increasing doses are given at intervals of twenty-four hours for three days in succession, was tried, with success in some cases but not in others. A method was next tried in which the rabbit was given a small initial dose, followed seventy-two hours later by three larger doses with an hour's interval between them. This method, like the preceding one, gave excellent results in some cases, but less satisfactory ones in others. It became necessary, therefore, to study the question of the production of agglutinin by the rabbit for the meningococcus more carefully than yet appears to have been done.

The following experiments were the first of a set undertaken for this purpose. All of the rabbits used were young ones. They were injected intravenously with a standardized suspension of the meningococcus (*See* "Identification of the Meningococcus," by Major M. H. Gordon). In making this suspension the twenty-four hours' growth of the coccus on legumin-agar plates is suspended in normal saline, heated to 65° C. for thirty minutes, standardized by its turbidity, and finally receives the addition of half per cent. of phenol as preservative.

The agglutinating titre of the serum was determined by the macroscopic method. Small test-tubes were used, three inches by a quarter of an inch. These are arranged in specially designed racks. The dilutions of serum are made in quarter cubic centimetre bulk in the tubes, and then an equal amount of suspension is added. The present results were all obtained at 55° C. and read off after twenty-four hours.

Series A.

Seven young rabbits, all weighing within sixty grammes of a kilogramme, each received one hundred and fifty millions of killed meningoccus, type I, of the present outbreak.

Rabbit I received the 150 million cocci in one dose.

Rabbit II received two doses each of 75 millions with an hour's interval between them.

Rabbit III received three doses each of 50 millions with an hour's interval between them.

Rabbit IV received the same three doses as rabbit III, but at twenty-four hours' interval.

Rabbit V received 25 millions and then, twenty-four hours later, 50 millions, and after a further interval of twenty-four hours 75 millions.

Rabbit VI received the same amounts as Rabbit V, but at forty-eight hours' interval instead of twenty-four hours.

Rabbit VII received 30 millions the first day and, seventy-two hours later, three doses of 40 millions at hourly intervals.

About half a cubic centimetre of blood was drawn from each rabbit's ear before the first injection and daily until fourteen samples had been taken from each animal; the blood on any day on which a dose was given being taken before the injection. The serum was separated from these and titrated against the standard suspension in the manner previously described.

The result is best seen in the accompanying curves (Chart I), where the limit of well-marked macroscopic agglutination on the various days is plotted.

In none of these rabbits did the serum show any degree of agglutination beyond a trace in the 1 in 10 dilution until the fourth day. On that day, however, there was definite agglutination with four of the sera up to the 1 in 100 dilution. On the fifth day the titre rose in all, except in the case of rabbits IV and VII. On the sixth or seventh day the titre reached 1 in 500 in all except rabbits VI and VII, the last of which did not reach this point until the ninth day. The titre of all the other sera began to fall about the eighth day. It is noteworthy that rabbit VI, in which the interval between the doses was longest (forty-eight hours), did not show a titre of over 1 in 200.

With one exception, the weights of these rabbits steadily rose by some two hundred or three hundred grammes during the period of this experiment. The exception was rabbit III, which died of peritonitis on the fifteenth day (apparently brought about by the bursting of a parasitic cyst in the liver).

Chart I.

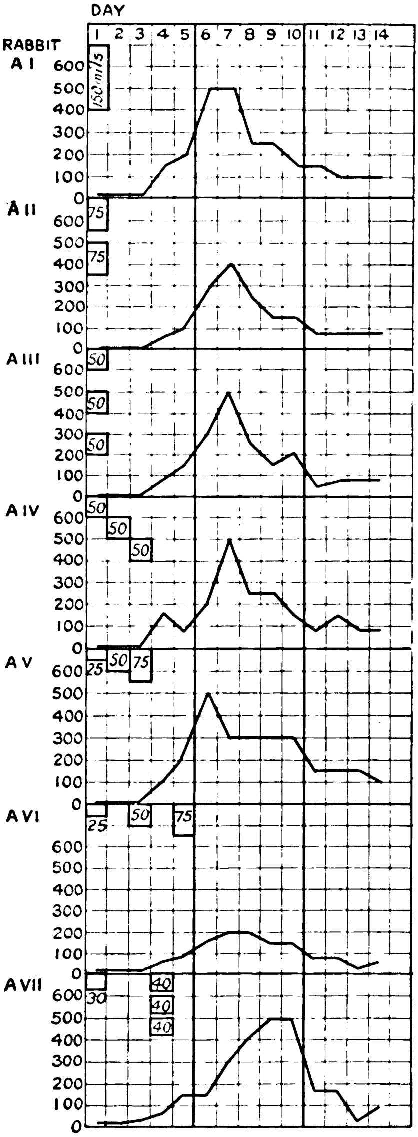
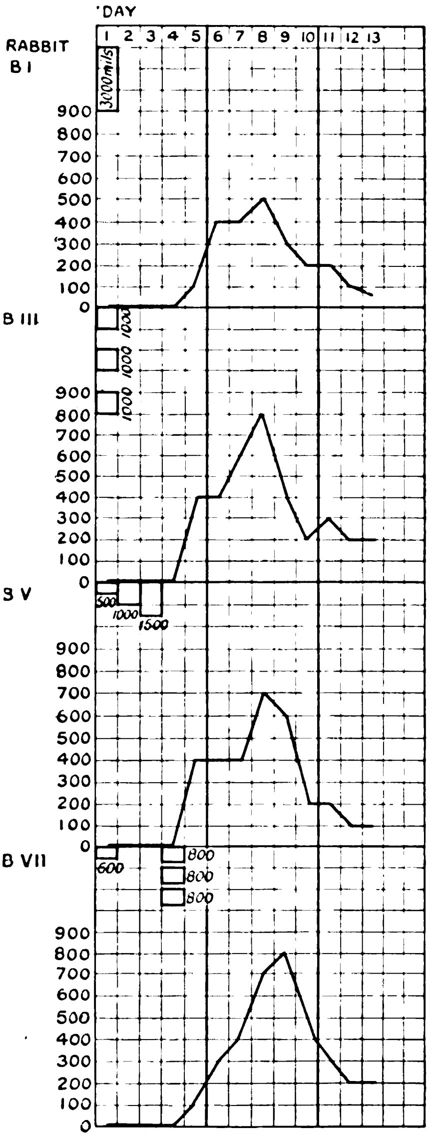


Chart II.



The figures on the left of each chart show the dilution of the serum, i.e., 700 means 1 in 700 dilution. Each dose of cocci is indicated by a rectangle, the numbers showing the number of millions per dose.

Series B.

In order to repeat the salient features of the preceding series, and to see at the same time if a better titre was to be obtained by increasing the size of the dose, four further rabbits were injected, each weighing just over one thousand one hundred grammes. The four rabbits in this series each received three thousand million of killed meningococci Type II. They were injected in the same way and with the same proportionate dose as rabbits I, III, V, and VII respectively of Series A had been, but in the present case each rabbit received twenty times the dose then given.

The results are shown in the curves recorded in Chart II. As in the case of the first series, the weights of the rabbits increased normally during the experiment.

The larger dose seems to have delayed the appearance of the agglutinin somewhat, but to have made it about sixty per cent higher. Rabbits III and VII gave the best results ; that is to say, one large dose seems to be less efficacious than fractions of it given at short intervals, though aggregating the same.

The titre of 1 in 800 thus obtained in eight days is quite a workable one for the practical purpose of identifying the meningococcus, and, as these results may be useful to other workers, they are therefore now described. Further experiments amplifying them are in progress.

NOTES ON THE TREATMENT OF SLEEPING SICKNESS IN YEI SLEEPING SICKNESS CAMP, CONTINUED UP TO APRIL, 1915.

By Captain J. T. SIMSON.
Royal Army Medical Corps.

In the previous notes on treatment compiled by the late Captain H. S. Ranken, V.C., R.A.M.C., last year, attention was drawn to two series of cases still under treatment, with Antimony and Salvarsan, and with Antimony and Atoxyl combined, the total of the two series numbering one hundred and forty-five persons, but it was pointed out that it was still premature to tabulate any results on these for another year. This period has now elapsed, and it is with these one hundred and forty-five cases that the following notes have to deal.

Explanation of Terms used.

In describing the condition of the patients the following relative terms have been used :—

Very Good. Good. Fair. Poor.

These terms cannot be said to correspond to any of the classical stages of the disease, but are found convenient for purposes of tabulation.

By *Good Condition* it is roughly meant that the patient has no outward signs of the disease and that he is in good physical and mental condition.

Very Good is used to express persons in exceptionally good condition and also for the persons who come to the camp in good condition but who have obviously improved.

By *Fair* is meant persons who are only moderately strong—physically and mentally, and who show some outward manifestation of their disease.

By *Poor Condition* is meant persons who are obviously going downhill, and including all in the most advanced stages of the disease.

First Series.

Treatment with *Antimony* and *Salvarsan* combined.

These patients received 5 doses of one grain metallic antimony at three days' interval intravenously. Then 0·4 gramme salvarsan

also intravenously. Then 5 more doses of antimony as before. Then 0·4 gramme salvarsan. Then 5 further doses of antimony.

In all these cases the peripheral blood was examined at three-monthly intervals (six slides being examined).

Twenty-six selected persons were given the above course of treatment and with three exceptions they have all been under observation in the camp for over two years. Of these, 5 have died, 15 are in good condition, 4 are in fair condition, and 2 are in poor condition. Of the 15 in good condition, 1 was found to have trypanosomes in his blood five months after treatment had been omitted; he was given further treatment with atoxyl. He is still in good condition. Of the 2 said to be in fair condition, 1 after a year from treatment was an obvious case of "clinical relapse," although the blood results were always negative.

Second Series.

Treatment with *Antimony* and *Atoxyl.*

This series must be subdivided into two.

First Subdivision.

Twenty-three persons who were picked out as being in particularly good condition on admission were treated as follows:—

Five doses of antimony (one grain) at three days' interval. Then twelve doses (five-grain) of atoxyl at three days' interval. Then five further doses of antimony, Then a second course of atoxyl. Then a third course of antimony and a third course of atoxyl.

After this all treatment was permanently stopped. As before, the very large majority of these cases have been under observation for two years and many of them much longer.

Of these 23 cases, 1 has died, 2 are in very good condition (and 1 of these has shown distinct improvement), 14 are in good condition, 5 are in fair condition, and 1 is in poor condition.

The Second Subdivision.

These cases have received more or less continuous treatment with antimony and atoxyl for two years after admission. A definite scheme of treatment embracing the whole class cannot be given as this has varied a good deal according to the condition of the individual concerned.

But the following is a fairly typical example of the class as a whole:—

Five injections one grain of antimony at three days' interval. Six injections of atoxyl one gramme at ten days' interval. Rest for one month. Five further injections of antimony, 6 injections of atoxyl at twenty days' interval. One month's rest. Further course of 6 injections of antimony and then atoxyl.

After this, treatment was continued up to two years with atoxyl, the dose always being one gramme and intervals of one month's rest being given between the courses.

This sub-division comprises 96 cases. Of these 1 deserted from the camp, 21 have died, 37 are in good condition, 31 are in fair condition, and 6 are in poor condition.

PERCENTAGES.

(1) *Antimony* and *Salvarsan*.—In this class the percentage of persons at present in good condition is 53·8, and the percentage of deaths is 19·2.

(2) *Antimony* and *Atoxyl* (First Sub-division).—Percentage of persons in good condition is 69·5; percentage of deaths 4·3.

(3) *Antimony* and *Atoxyl* (Second Sub-division).—Percentage of persons in good condition is 38·3; percentage of deaths 21·5.

It must be taken into consideration that Classes 1 and 2 were persons specially selected as suitable for the treatment, whereas persons in Class 3 were not so selected, and also that the diet given to the patients cannot in any degree be called a generous one.

No attempt is being made in this note to draw any conclusions as to the results of the various treatments, as the late Captain Ranken, V.C., was most anxious that this should not be done prematurely.

A REPORT ON THE INJECTION OF ANTITETANUS SERUM IN TETANUS CASES.

By K. W. GOADBY, M.R.C.S., L.R.C.P., D.P.H.(Cantab), Etc.
Bacteriological Specialist attached Royal Herbert Hospital.

I HAVE collected in the present short report notes of eight cases of tetanus, in which an examination of the cerebrospinal fluid, withdrawn after injection, has been made. The cases have all been treated with a similar antitoxin, but the report does not include all the cases of tetanus which have occurred at the Royal Herbert Hospital since October, but only those in which examination of the cerebrospinal fluid has been undertaken. The details of the cases have been tabulated for purposes of comparison, and it is proposed to carry out further investigation should more cases arise. In addition to the tables a short résumé of the clinical side of the cases is also given, for which I am indebted to Mr. R. H. Jocelyn Swan, under whose care the cases were.

The toxin and antitoxin content of the samples were determined by Dr. MacConkey, at the Serum Laboratory of the Lister Institute at Elstree. The routine method adopted in dealing with the fluid was as follows: The fluid was collected under aseptic precautions, before the administration of the antitoxic serum, direct into sterile bottles, and sent to Elstree; the material was tested for toxin by the injection of two cubic centimetres into a mouse, the antitoxin by injection into a guinea-pig with an appropriate quantity of tetanus toxin.

The tables appended are arranged to show :—

(*a*)

(1) The incubation period of the disease.
(2) The quantity of antitoxin injected and method.
(3) Clinical features and nature of wound.
(4) Prodromal symptoms.

(*b*)

(1) Prophylactic injection.
(2) Antitoxin administered for treatment after appearance of symptoms of tetanus.
(3) Antitoxin content of cerebrospinal fluid.

The number of cases is at present too small to base any far-reaching conclusions regarding the relation of recovery to antitoxin content of the cerebrospinal fluid subsequent to injection.

Case 3 is of interest as 80,000 U.S.A. antitoxin units were

given in a period of twenty-three days; on the two occasions it was examined, the fluid only contained 1 U.S.A. unit of antitoxin, although when the cerebrospinal fluid was examined on November 18, 75,000 U.S.A. units had been administered.

In only one case (No. 5) was a greater amount than two U.S.A. units of antitoxin found per cubic centimetre examined. There is, however, sufficient evidence to show that the antitoxin content of the cerebrospinal fluid rapidly diminished after the injection, and in view of the experiments of Parks it is legitimate to infer that it becomes absorbed by the poisoned nerve tissues. In Parks's experiments animals inoculated with a minimal lethal dose of tetanus toxin simultaneously with an intravenous or subcutaneous injection of antitoxin died, but if the injection of antitoxin was made intrathecally the animals recovered.

In the cases tabled the same variety of tetanus antitoxin was used throughout, with the exception of No. 8, when the supply was temporarily exhausted.

Case 6 is interesting in that no definite symptoms occurred for fifty-eight days, and a prophylactic dose of anti-tetanus toxin was given on the date of wounding.

In one case only, No. 8, was the *B. tetanus* isolated; in this case 0·2 cubic centimetre of a seven days' broth cultivation killed a guinea-pig in thirty-six hours with generalized tetanus.

The tables suggest that intrathecal injection of antitoxin should be persisted in with all cases of tetanus. No symptoms other than urticarial rashes have appeared save in one case, 6, and in this instance symptoms of anaphylaxis came on during the intravenous injection of antitoxin immediately after the intrathecal injection. In a series of meningitis cases a death from anaphylaxis took place during an intravenous injection of serum following an intrathecal injection. In view of Parks's work, quoted above, and the risk of anaphylaxis following the combined intrathecal and intravenous injections, it would appear advisable in treating tetanus to adhere to the intrathecal route entirely as safer and more efficacious.

The serum T 41, used in all these cases, is the specially refined and concentrated serum prepared by the Lister Institute of Preventive Medicine.

Case 1.—No. 434 Private J. B., 2nd Carabiniers, aged 21. Compound comminuted fracture of right femur, large wound on the inner side and smaller wound behind the thigh. Wounded at Ramscapelle. Onset of tetanic signs occurred on November 7 (nine days). Spasms of back were noted as premonitory symptoms. Earth and bits of clothing were found in the wound. Treatment:

opening, thorough drainage, H_2O_2. Septic wound. Result: tetanus spasms not severe. Rapid pulse. Died November 14.

CASE 2.—No. 58239 Private Van de H., aged 19. Superficial wound on the back behind the right scapula. Wounded at Cas Roche on October 29, 1914. Onset of tetanic signs occurred on November 5. The premonitory symptoms were contraction of right arm and forearm, cervical and abdominal rigidity. Earth and bits of clothing were found in the wound. Treatment: chloral bromide. Result: good recovery.

CASE 3.—No. 27357 Private P. D., 1st Reg. Chasseurs. Superficial wounds of face, neck, arms and leg. Deep wound on inner side of left thigh. Wounded at Cas Roche on October 29, 1914. Onset of tetanic signs on the seventh day, November 5, 1914. The premonitory symptoms were trismus, cervical spasms, stiffness in left leg and opisthotonos. Earth and bits of clothing were found in the wound. Treatment: thigh wound cleaned and drained. Foreign bodies (cloth) removed. Result: slow but good recovery. Tonus of left leg remained long after right, also increased knee-jerks in left, and ankle clonus.

CASE 4.—No. 7062 Lance-Corporal H. L. L., 1st Royal Scottish Fusiliers, aged 30. Gunshot wound in right shoulder, shattered end of clavicle. Wounded on November 10, 1914. Onset of tetanic signs, November 28 (eighteen days). The premonitory symptoms were pain and stiffness in the right arm, trismus and cervical rigidity. Wound cleaned up and drained. Foreign bodies not noted. Treatment: irrigation, H_2O_2. Good recovery.

CASE 5.—No. 12625 Private G. F., aged 22. Frost-bite, November 21, 1914, right foot, septic. Onset of tetanic signs, December 4, on boat coming over. The premonitory symptoms were trismus, cervical and dorsal rigidity. Treatment: fomentation, morphia, oxygen to wound, saline intravenously. Result: died December 9, 11 p.m. Very severe case. Cyanosis, respiratory dyspnœa, laryngeal stridor, frequent general spasms.

CASE 6.—No. 1325 Private B. (B.L.N.), 6th Gordon Highlanders, aged 19. Wounded on back of head, scalp, and left shoulder, at Ypres, on March 14, 1915. Onset of tetanic signs: stiffness in left arm, with recurrent spasm, May 11, 1915. Premonitory symptoms: admitted to Royal Herbert Hospital, Woolwich, for "rheumatism," May 10, 1915. Pulse 120, temperature 99° F. Earth and bits of clothing in wound. One small unhealed sinus in supraspinous fossa of left shoulder. Treatment: morphia, chloral, anæsthetics for lumbar puncture, catheterization, May 12, 1915. Result: recovery.

TETANUS CASES.

Table A.

Antitetanus Serum Administration.

Case No.	Date wounded	Locality	Nature of wound	Prophylactic injection serum. Method	Units	Date	Prodromal symptoms	Date	Antitetanus serum. Date	Intrathecal	Intravenous	Make	Result
1	Oct. 29, 1914	Ramscapelle	Severe. Fracture comp., right femur (comminut.). Large wounds inner side and behind thigh	Hypodermic	4,000 T 41	Nov. 3	Spasms of back ..	Nov. 7 (9th day)	Nov. 3	..	Hypodermic, 4,000	T 41 Lister	Death, Nov. 14, 7 days. Spasms not severe. Rapid pulse. Wound very septic.
									,, 9	4,000	..	,,	
									,, 10	4,000	..	,,	
									,, 11	4,000	..	,,	
									,, 12	4,000	..	,,	
									,, 13	4,000	..	,,	
2	Oct. 29, 1914	Cas Roche	Suppurating wound on the back behind right scapula. Bits of clothing in wound	Hypodermic	2,500 T 41	Nov. 6	Contraction right arm and forearm, cervical and abdominal rigidity	Nov. 5 (7th day)	Nov. 6	..	Hypodermic, 2,500	T 41 Lister	Recovery, Nov. 20, 15 days.
									,, 7	4,000	..	,,	
									,, 8	4,000	..	,,	
									,, 9	4,000	..	,,	
									,, 10	4,000	..	,,	
									,, 11	4,000	..	,,	
									,, 12	4,000	..	,,	
									,, 13	4,000	..	,,	
									,, 14	4,000	..	,,	
									,, 15	4,000	..	,,	
3	Oct. 29, 1914	Cas Roche	Slight. Peppered about face, neck, arms, and leg. Deep perforating wound inner side of left thigh. Bits of clothing in wound	Hypodermic	500 T 41	Nov. 5	Stiffness of left leg, trismus, cervical spasm, opisthotonos	Nov. 5 (7th day)	Nov. 5	..	Hypodermic, 500	T 41 Lister	Recovery, Nov. 30, 25 days.
				ditto	,,	,, 6			,, 6	4,000	Ditto 500	,,	
									,, 7	4,000	..	,,	
									,, 8	4,000	..	,,	
									,, 9	4,000	..	,,	
									,, 10	4,000	Intravenous, 4,000	,,	
									,, 11	4,000	..	,,	
									,, 12	4,000	..	,,	
									,, 13	4,000	..	,,	
									,, 14	4,000	..	,,	
									,, 15	4,000	..	,,	
									,, 16	4,000	..	,,	
									,, 17	4,000	..	,,	
									,, 18	4,000	..	,,	
									,, 23	500	..	,,	
									,, 25	500	..	,,	
									,, 28	—	500	,,	

4	Nov. 10 1914	..	Shattered right clavicle	..	..	..	Stiffness right arm, pain, trismus, cervical rigidity	Nov. 28 (18 days)	Nov. 28 ,, 29 Dec. 1	4,000 4,000 4,000	.. .. ..	T. 41 Lister ,, ,,	Recovery, 5 days.
5	Nov. 21, 1914	..	Frost-bite, right foot	Hypo-dermic	On boat	Dec. 4	Cervical and dorsal rigidity, trismus	Dec. 4 (13 days)	Dec. 4 ,, 5 ,, 6 ,, 8 ,, 9	? 4,000 4,000 4,000 4,000	Hypodermic .. .. .. Intravenous, 4,000	? T 41 ,, ,, ,,	Death, Dec 9, 6 days.
6	Mar. 14, 1915	Ypres	Moderate. Back of head, scalp, left shoulder	Hypo-dermic	500	Mar. 14	Stiffness left arm, with recurrent spasm	May 11 (58 days)	Mar. 14 May 11 ,, 12 ,, 13 ,, 14 ,, 16 ,, 18	500 4,000 4,000 4,000 4,000 4,000 ..	Hypodermic .. .. Intravenous, 8,000 .. .. Intravenous, 500	? T 41 ,, ,, ,, ,, ,,	Recovery, May 20, 9 days
7	April 24, 1915	Ypres	Amputated left leg above knee, April 26	Hypo-dermic	? 500	April 24	Twitching, left buttock, spreading to leg and arm (left)	May 10 (16 days)	May 11 ,, 12 ,, 13	6,000 4,000 4,000	 4,000	T 41 ,, ,,	Recovery, May 27, 16 days.
8	May 3, 1913	Ypres	Perforating wire, right buttock, no clothing	?	?	?	Twitching, right buttock and right leg, spreading to side, arm, and abdomen	May 10	May 10	4,000	..	B. W. & Co.	Death, May 11.

TETANUS CASES.

TABLE B.

Examination of Cerebrospinal Fluid of Tetanus Cases for Tetanus Antitoxin and Toxin.

Case No.	Injection of antitoxin						Examination of cerebrospinal fluid					Notes	Result
	Date	Time	Hypodermic	Intravenous	Intrathecal	Make	Date L. P.	Time	Quantity fluid	Toxin in 1·0 c.c.	Antitoxin in 1·0 c.c.		
1	1914 Nov. 3	..	4,000 units	–	–	Lister T 41	..	..	..	..	..	..	..
	,, 9	8 a.m.	..	..	4,000 U.S.A. units	,,	..	..	..	..	..	..	..
	,, 10	12 noon	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 11	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 12	,,	..	..	4,000 ,,	,,	..	..	..	..	..	*24,000 U.S.A. units total*	..
	,, 13	,,	..	..	4,000 ,,	,,	Nov. 13	12 noon	40 c.c.	No effect on mouse 25 grammes	1 but not quite 2 U. S. A. units	Spasms not severe	Died Nov. 14
2	Nov. 6	12 noon	2,500 units	..	–	Lister T 41	..	..	..	..	..	..	..
	,, 7	,,	..	..	4,000 U.S.A. units	,,	..	..	..	..	..	..	..
	,, 8	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 9	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 10	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 11	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 12	,,	..	..	4,000 ,,	,,	Nov. 12	12 noon	..	2 c.c. no effect on mouse 25 grammes	$\frac{1}{10}$ U.S.A. unit antitoxin	..	..
	,, 13	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 14	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 15	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 17	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	Recovered.

3	Nov. 5	–	500 U. S. A. units	..	–	Lister T 41	..	..	..	..	..	..	..
	,, 6	10 a.m.	500 U. S. A. units	..	4,000 U.S.A. units	,,	..	..	..	..	..	..	..
	,, 7	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 8	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 9	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 10	9 a.m.	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 10	2 p.m.	..	4,000 U.S.A. units	–	,,	..	..	..	..	..	..	..
	,, 11	10 a.m.	..	..	4,000 U.S.A. units	,,	..	..	..	..	..	..	..
	,, 12	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 12	2 p.m.	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 13	10 a.m.	..	..	4,000 ,,	,,	Nov. 13	10 a.m.	30 c.c.	2 c.c. no effect on mouse 25 grammes	Contained 1, less than 2, U.S.A. units	..	..
	,, 14	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 15	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 16	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 17	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 18	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	,, 23	,,	..	..	500 ,,	,,	Nov. 18	10 a.m.	25 c.c.	..	Contained 1 U.S.A. unit	Total units given = 80,000 U.S.A. units	Slow recovery.
	,, 25	,,	..	..	500 ,,	,,	..	..	..	..	..	..	..
	,, 28	,,	..	500 U. S. A. units	–	,,	..	..	..	..	..	..	..
4	Nov. 28	10 a.m.	..	..	4,000 U.S.A. units	Lister T 41	..	..	..	..	..	..	..
	,, 29	,,	..	..	4,000 ,,	,,	..	..	..	..	..	..	..
	Dec. 1	,,	..	..	4,000 ,,	,,	Dec. 1	10 a.m.	..	2 c.c. no effect on mouse 30 grammes	Did not contain $\frac{1}{300}$ U.S.A. unit	Total units given, 12,000	Recovery.
5	Dec. 5	6 p.m.	..	..	4,000 U.S.A. units	Lister T 41	Dec. 5	6 p.m.	..	2 c.c. no effect on mouse 25 grammes	Contained less than $\frac{1}{300}$ U.S.A. unit	..	..
	,, 6	8 ,,	..	..	4,000 ,,	,,	,, 6	8 ,,	..	..	Contained 2 U.S.A. units	..	..
	,, 8	6 ,,	..	..	4,000 ,,	,,	,, 8	6 ,,	..	..	Contained $\frac{1}{10}$ U.S.A. unit	..	..
	,, 9	10 a.m.	..	4,000 U.S.A. units	4,000 ,,	,,	,, 9	10 a.m.	..	..	Contained 5 U.S.A. units	Total units given, 20,000	Death.

TETANUS CASES. TABLE B.—*Continued.*

Case No.	Injection of antitoxin: Date	Time	Hypodermic	Intravenous	Intrathecal	Make	Examination of cerebrospinal fluid: Date L. P.	Time	Quantity fluid	Toxin in 1·0 c.c.	Antitoxin in 1·0 c.c.	Notes	Result
6	1915 Mar. 14	–	500 U.S.A.	–	–	Not known	..	..	..	..	..	..	..
	May 11	10 a.m.	–	..	4,000 U.S.A. units	T 41	May 11	10 a.m.	25 c.c.	..	..	..	..
	,, 12	,,	–	..	4,000 ,,	,,	,, 12	,,	20 ,,	..	Did not contain 0·1 U.S.A. unit	..	..
	,, 13	,,	–	8,000 U.S.A. units	4,000 ,,	,,	,, 13	,,	30 ,,	..	Contained + 0·1 but – 1·0 U.S.A. unit	..	..
	,, 14	,,	..	..	4,000 ,,	,,	,, 14	,,	25 ,,	..	..	Total units given = 28,000	Anaphylaxis on May 18, with small intravenous injection diluted serum.
	,, 16	,,	..	..	4,000 ,,	,,	,, 16	,,	25 ,,	..	Contained 1·0 U.S.A. unit	..	..
	,, 18	,,	..	10 c.c. serum and saline, āā		,,	..	..	..	..	..	..	Recovery.
7	Apr. 22	?	500 U.S.A. units	–	–	?	..	..	..	..	..	..	..
	May 11	10 p.m.	..	..	4,000 U.S.A. units	T 41	May 11	10 p.m.	25 c.c.	..	..	..	..
	,, 12	10. am.	..	..	4,000 ,,	,,	,, 12	10 a.m.	20 ,,	..	Contained + 0·1 but – 1·0 U.S.A. unit	..	..
	,, 13	,,	..	4,000 U.S.A. units	4,000 ,,	,,	,, 13	,,	20 ,,	..	Contained + 0·5 but – 1·0 U.S.A. unit	..	..
	,, 14	,,	..	..	4,000 ,,	,,	,, 14	,,	20 ,,	..	Contained + 2·0 but – 5·0 U.S.A. unit	..	Recovery.
8	May 1	..	..	..	..	..	..	..	..	..	..	..	..
	,, 10	2 p.m.	..	..	4,000 U.S.A. units	B. W. & Co. 701/2D.29B	May 10	2 p.m.	35 c.c.	2 c.c. no effect on mouse 30 grammes	Contained + 0·3 U.S.A. unit	..	Death.

CASE 7.—No. 1256 Lance-Corporal G., Gloucesters, aged 38. Amputation of left leg above knee, April 26, 1915, at base in Boulogne. Wounded at Ypres on April 24, 1915. Premonitory symptoms: twitching of left buttock, spreading to leg and arm same side. Recurrent spasm. Operation: amputation. Treatment: chloral hydrate, morphia. Result: recovery.

CASE 8.—Lance-Corporal R. Wound (gunshot) right buttock, one pocket two inches deep in muscle. Wounded at Ypres on May 3, 1915. Onset of tetanic signs, 2 p.m., generalized tetanic spasms, commencing right leg and involving whole of body. Could open mouth easily. Sternomastoids involved. Premonitory symptoms: irritability May 9, May 10 stiffness general, 7 a.m., 10 a.m. twitching of right buttock and right leg. Operations: sinus slit up and scraped with spoon. Tetanus bacilli recovered from wound: 0·2 c.c. seven days' broth culture killed mouse in thirty-six hours with tetanus. Result: died 7 p.m., in acute spasm.

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Clinical and other Notes.

REMOVAL OF A BULLET FROM THE RIGHT VENTRICLE OF THE HEART UNDER LOCAL ANÆSTHESIA.

By Lieutenant L. H. C. BIRKBECK and Lieutenant G. N. LORIMER.
Royal Army Medical Corps.
With Remarks by Colonel H. M. W. Gray, Consulting Surgeon to the British Expeditionary Force, France.

No. 14727 Private N. A., was admitted to a general hospital on July 19, 1915, having been wounded eight days previously. The bullet had passed through and killed a man in front of him. He was knocked down, but did not lose consciousness, and had not had any discomfort other than slight pain from the wound. There was a small dirty wound (half an inch in diameter) just below and to the right of the xiphi-sternal junction, and also a painful swelling of the right parotid gland, which disappeared next day. The patient showed no other symptoms during the first few days. He was kept in bed. The heart appeared to be normal and regular. The pulse varied between 80 to 90. The evening temperature rose to 100° to 101° F.

The following X-ray report was received from Captain S. F. McDonald: "There was an entry wound in the right epigastrium, but on examination no shadow could be seen in the abdomen.

"Thorax: Lungs and pleural cavities were normal. Diaphragm moved well and evenly on both sides. Heart was normally situated, but there was some slight increase of cardiac shadow on the right side.

"In the lower portion of the heart shadow was a very sharply defined dark shadow moving with the heart and also apparently laterally in relation to the heart.

"This last movement suggested that the object was free in the pericardial cavity, but on turning the patient over it was seen to lie quite definitely in the substance of the heart. It had a distinct rocking movement. No antero-posterior movement was visible in relation to the heart.

"The object seemed to be in or close to the lowest portion of the wall of the right ventricle.

"Its shape and size, so far as could be made out, were those of a rifle bullet. Attempts to take radiograms were unsuccessful."

Colonel Gray, consulting surgeon, saw the patient first on July 25, and again on 26th, on which day a sharp pain developed suddenly in the left leg. As the pulse during the night of the 26th had shown some irregularity (rate 65 to 95), and the heart had occasionally dropped

beats, an operation was decided on and performed on the morning of the 27th. Veronal, 5 grains was given the night before, and three doses of morphia, amounting in all to $\frac{5}{8}$ grain during the morning before operation. The patient was not unduly under the influence of morphia. He was screened again just before the operation and conversed, sat up and turned himself smartly when asked to do so.

Operation by Colonel Gray.—Under local anæsthesia (eucaine 1 per cent, potass sulphate $\frac{1}{4}$ per cent and adrenalin) a wide horseshoe-shaped incision was made, convexity upwards, extending along the sixth costal cartilage on each side and across the sternum at the level of the attachment of the fifth cartilage. This incision was used so as to make an exposure of the track of the bullet in the depth. The perichondrium was separated from the left sixth cartilage, which was cut across at the costo-chondral junction and used as a lever to elevate the sternum, while the triangularis sterni, pericardium, etc., were being separated off the posterior aspect of the flap. A small portion of the right sixth rib was removed close to the costo-chondral junction. The sternum, at the lower border of the fifth costal cartilages, was grooved deeply with a gouge and divided with a bone forceps. The soft parts were then separated from the sternum and ribs, so that the flap could be turned downwards and forwards. When the flap was pulled forwards a hole about an inch long appeared in the pleura on the right side, in the track of the bullet. The right lung collapsed. The respirations became laboured and quick, the patient coughed jerkily; he became anxious and complained that he was breathless. The colour remained good, and he settled down in about one minute after being reassured by the surgeon. Except for this disturbance there was apparently no discomfort during the entire operation.

The flap was held forward by hooks, and the pericardium opened obliquely from the base to near the apex of the heart. About a drachm of slightly blood-stained fluid was noticed in the pericardial cavity. The heart looked normal. No wound could be seen. On digital exploration, the bullet was felt to be lying, apparently fixed, at the back of the heart, either in the wall or cavity of the right ventricle. The point of the bullet was near the apex of the ventricle. During the manipulations the heart was noticed to miss a beat occasionally—when touched at the upper and back part of the inter-ventricular septum. The right ventricle was seized with a pair of catch forceps near the apex. When it was seen that this caused no disturbance, a suture was passed through the muscle adjacent, and by these the heart was held forward. This in no way agitated the patient. On further exploration the bullet was definitely located by probing with a needle and found to be fixed in the right ventricle near the posterior coronary vessels. After manipulation, the bullet was felt to change position and to be free inside the ventricle. It was worked away as far as possible from the coronary vessels and

grasped between the thumb and finger. Two stitches were inserted into the muscle wall over the bullet. The wall of the ventricle was incised for half an inch and the bullet removed with forceps. While the wall of the ventricle was still being held firmly between the finger and thumb, the stitches were tied. On removing the catch forceps there was brisk bleeding, which was stopped quickly by an under-running stitch. The pericardial cavity was wiped free of blood-clot and was filled with normal saline to expel the air, and was then sewn up. The right pleural cavity was next filled with saline and the injured pleura sewn up. While the wound was being closed the chest was aspirated to remove the saline. This aspiration was the only part of the operation which seemed to cause the patient any pain.

The patient was wonderfully comfortable on being taken back to bed, but about four hours after the operation the respirations rose suddenly to 48 per minute, and remained at about that level till he died, except for part of the day of 29th and 30th, when, the patient being deeply under the influence of morphia, they dropped to 28 per minute. He was much troubled, after this occurred, by mucus collecting in large quantity in the throat and upper part of the trachea. Various remedies were tried for this with little avail. He took nourishment fairly well. Cardiac stimulants were used after the first two days.

On July 29 his mind began to wander, and he was often delirious till the time of his death on July 31, at 7.30 a.m. He lived nearly four and a half days after the operation.

There was never any indication that the operation on the heart had interfered with its action, which though quick (average 120 to 130) was wonderfully strong up to within a few hours of his death. No dropping of beats was noticed after the operation.

At the post-mortem examination it was found that the external wound had healed well. No sign of any inflammation. There was no exudation of either blood or pus into the pericardial cavity, but the heart was covered by a shaggy layer of lymph, about one-sixth inch thick. The wounds in the heart had healed perfectly. There were several shreddy, ante-mortem clots entangled in the chordæ tendineæ of the right ventricle and a long narrow clot in the pulmonary artery, extending into its right branch, besides the usual post-mortem clotting. There was an abrasion of the endocardium of the posterior wall of the right ventricle where the bullet had been lying, but the cavity looked normal otherwise. No wound of entrance was discovered. The heart was sent to the Royal College of Surgeons of England for further investigation.

There were several small clots in the branches of the pulmonary arteries with corresponding infarct areas in the lungs. The right lung had expanded to about two-thirds the size of the left. There were about two pints of blood-stained serous fluid in the right pleural cavity. The cause of death was judged to be multiple pulmonary infarction from clots derived from the right ventricle.

REMARKS BY COLONEL H. M. W. GRAY.

I should like to add to the notes of Lieutenant Birkeck and Lieutenant Lorimer that the irregularity of the pulse-rate (65 to 95) without extraneous cause, the occasional dropping of a beat, and the sudden pain and swelling in the right parotid and left leg (due possibly to small emboli), made me decide to operate. The patient was otherwise extraordinarily well, and showed no distress whatever. One did not care to risk postponing operation till the patient could be transferred to England.

The method of using th local anæsthetic was by infiltration of the line of incision and blocking of the intercostal nerves on each side from the fourth to the seventh. There was no anæsthetic injected into or around the pericardium or pleura.

Interesting points about the operation are:—

(1) The complete success of the local anæsthetic. So far as I can gather, this is the first occasion on which any operation on the exposed heart has been done with local anæsthesia alone. The patient was not deeply under the influence of morphia. He responded to questions, requests or suggestion at once.

(2) The evanescent nature of the distress when the right lung collapsed.

(3) The absolute absence of sensation of the pericardium, both parietal and visceral, and of the heart itself, to squeezing, pulling, pricking, cutting, or suturing. These manipulations caused apparently no interference with the cardiac action. During the extraction of the bullet, at least one half of the right ventricle was firmly grasped between the fingers and thumb. The heart missed a beat repeatedly whenever the upper and back part of the interventricular septum was pressed, but began to beat again at once when this pressure was removed. I could not assure myself that the ventricles alone were implicated. The patient denied having any discomfort during these times, or indeed at any time during the operation, except when the right lung collapsed and when the aspirating needle was being introduced into his chest, when he complained loudly of pain. Even swabbing out the pericardial cavity caused no pain. All these observations are very interesting when one thinks of the effect of similar manipulations of either bowel or parietal peritoneum.

(4) There was a little difficulty in being certain of the position of the bullet, owing to its proximity to the interventricular septum, which, when contracted, gave a similar sensation on palpation. Therefore, a straight needle was used to locate the bullet definitely.

(5) The method used to obtain rapid distension of the lung at the end of the operation, in the absence of a positive pressure apparatus. On account of commencing respiratory distress, aspiration was stopped after about twenty-five ounces of the saline solution were removed. It was thought that the remainder would be rapidly absorbed.

(6) The possibilities of future successful operations for intracardiac conditions, which are conjured up by the virtual success of this one. I understand that a French surgeon recently removed, with permanent success, a rifle bullet which had lain in the right ventricle for five months. Unfortunately, I cannot meantime give a reference to the account of his operation.

BRAIN ABSCESS IN A CASE OF PARATYPHOID B.

By Lieutenants R. L. SCOTT and W. H. JOHNSTON.

Royal Army Medical Corps.

The importance of a more accurate clinical and bacteriological differentiation between diseases of the coli group appears to be amply justified by the findings of the present campaign. Statistics are as yet incomplete, but those we have since the outbreak of hostilities demand a closer investigation of the interesting paratyphoid group. The following case of paratyphoid B which recently occurred at No. 1 General Hospital presents a particularly interesting complication.

The patient, aged 21, a private, was admitted into No. 1 General Hospital on February 3, 1915. He gave a history of feeling ill, with pains in the abdomen, diarrhœa and headache commencing on January 26. In addition, he now complained of pains in the back and legs. There were sordes, furred tongue, and characteristic spots on abdomen, which was tympanitic and tender on palpation; spleen enlarged. No abnormal signs in lungs and heart. Urine normal. Nothing characteristic in the fæces. Pulse 110; temperature 103° F.

On February 4 a provisional diagnosis of enteric fever was made, and the patient was removed to the isolation division of the hospital. He complained of severe pain in the right side of the head and seemed very ill and drowsy. The pulse became dicrotic. Cultures were made from the blood, but proved to be sterile. No organism of the typhoid group could be isolated from the urine or fæces.

On February 8 the patient developed a hemiplegia of the left arm and leg; his left facial and left hypoglossal nerves were also paralysed. He had incontinence of urine and fæces, but no vomiting. No abdominal or cremasteric reflexes could be elicited. His expression was clouded and he became more drowsy, dull and apathetic. He replied to questions very slowly, thickly and not immediately, and yawned occasionally. He complained of pain in the right temporal region and the back of the right ear. Percussion over these areas made him wince. There was no œdema over either mastoid, but tenderness was present over the right mastoid area, especially over the tip. Tenderness was also elicited over and down the right side of the neck in line with the internal jugular. On examination of the ears, beyond a slightly injected Shrapnell's membrane and a little injection around the handle of the malleus on the

right side, nothing of note was found. There were no signs of past or present middle-ear disease. Nose and throat examination revealed nothing abnormal. Examination of the fundi was difficult, but the edge of the right disc appeared rather hyperæmic and indistinct. The pulse was no longer dicrotic, but full and slow; the temperature, on the other hand, remained high.

A diagnosis of right temporo-sphenoidal abscess was made, and on the strength of the definite tenderness over the right mastoid it was decided to explore this region first, and if nothing should be found to trephine over the usual site. Unfortunately the patient collapsed under the anæsthetic before any operative procedure was begun. It was deemed inadvisable to proceed any further. Lumbar puncture was performed and ten cubic centimetres of clear cerebrospinal fluid were withdrawn under no excess of pressure; cultivations of it were sterile. The subsequent history of the case was characteristic of a gradually increasing intracranial pressure. Coma and full stertor developed on February 12, and death supervened the next morning.

Post-mortem examination revealed the following: The spleen, somewhat enlarged, was attached by recent adhesions to the diaphragm. The upper pole showed purulent softening. The walls of the greater part of the ileum were atrophic, thin, and transparent, and in parts intensely hyperæmic. There was a uniform enlargement of the corresponding mesenteric glands, those in the ileo-cæcal angle being most markedly affected. In that area individual glands were as large as beans; some were fused by an inflammatory œdema and showed on section central necrosis. The serious aspect of the cæcum presented a picture of intense hyperæmia with numerous adhesions. The lymphadenoid tissue of the ileum appeared to be but slightly affected, considering the amount and severity of the ulceration. The appearance suggested a general hypoplasia of the lymphadenoid tissue. Ulceration was confined to the lower two feet of the ileum and to the adjacent portion of the cæcum. The ulcers, irregularly placed, were pitted, varying in size from a pea to a shilling, with sinuous edges raised towards the mucous coat, well marked and slightly indurated, resting on the muscularis mucosa the floor was granular and of the usual striated appearance. The opposed area of serous surface showed neither localized peritonitis nor adhesions, and there was an entire absence of subserous follicles suggestive of tubercular infection. The ulcers did not tend to encircle the gut, but had a follicular distribution, apparently with no definite relation to the lymphadenoid tissue. They suggested an acute process and appeared of recent formation. The largest, occurring near the ileo-cæcal valve, measured three quarters of an inch across. The lesions were not typical of either enteric fever or tuberculosis. The vessels of the dura mater were unduly injected. Beyond a slight engorgement of the capillaries leading down from the anterior part of the Sylvian fissure, the arachno-pial membrane was

normal. There was a considerable œdema of the right brain, well seen in the frontal and temporo-sphenoidal lobes. The right hemisphere was much larger than the left, overlapping it along the longitudinal fissure and to a certain extent displacing it. On section, an abscess about the size of a shilling was found embedded in the outer and posterior aspect of the right optic thalamus. The adjacent limb of the right internal capsule was partially destroyed. Pigmentation and encapsulation were absent. The œdema on section was very obvious. There was the usual displacement and distortion of mesial structures, the fornix being pushed aside and the left ventricle being flattened. The abscess had not ruptured into the right ventricle.

For the following report we are indebted to Lieutenant M. K. Acheson, M.A., M.D., Bacteriologist, No. 1 General Hospital:—

"Several attempts were made with negative results during life to isolate from the blood, fæces, urine, and cerebrospinal fluid the organism causing the patient's illness. At the post-mortem a non-motile, Gram-negative bacillus was obtained in pure culture from the spleen. In bile salt glucose and mannite it gave acid and gas; no change took place in bile salt lactose.

"The Bordet-Durham reaction was tried, with the results shown in the following table:—

"DILUTION.

	1 in 40	1 in 80	1 in 160	1 in 320	1 in 1,000
Typhoid	Complete ..	Partial ..	Partial ..	Negative	Negative.
Paratyphoid A ..	Almost complete	,, ..	Very slight	,,	,,
,, B ..	Complete ..	Complete	Partial ..	Partial ..	Partial.
Gaertner ..	No agglutinating serum available.				

"As the brain was at once placed in formalin solution, no bacillus could be isolated from the abscess when sections were cut.

"It is unfortunate that the Bordet-Durham reaction for Gaertner could not be performed, but the evidence, both clinically and bacteriologically, seemed fairly conclusive that the disease was due to the *Bacillus paratyphosus* B."

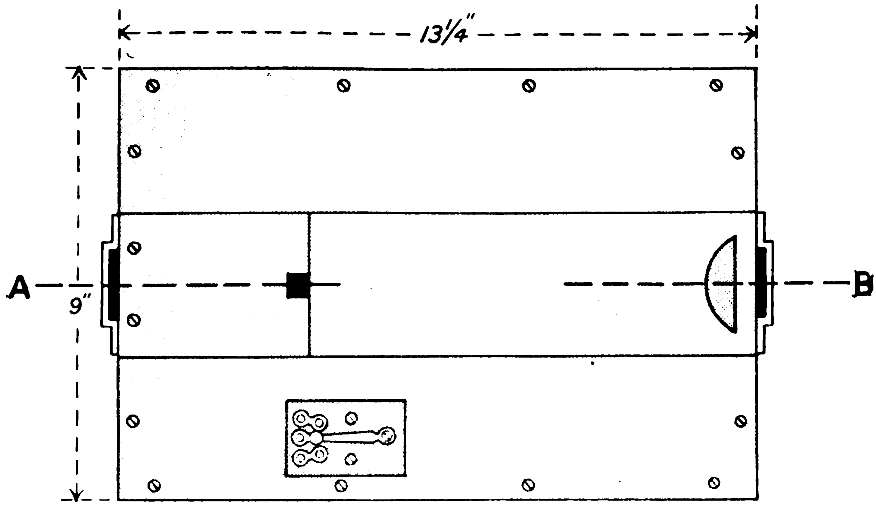
A FIELD ELECTRIC LAMP.

By MAJOR G. H. BROWN.
Royal Army Medical Corps.

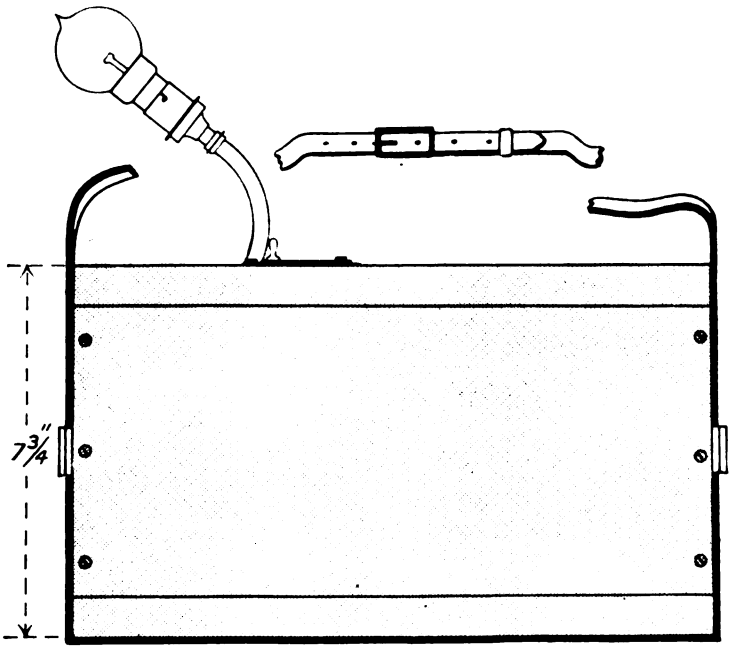
THE accompanying scale drawings illustrate a form of portable electric lamp suitable for dug-outs used as advanced dressing stations. The lamp figured was made in the field.

Battery.—8 dry cells ($1\frac{1}{2}$ volts), giving 12 volts. These are arranged four on each side of the box, and are wired in series. Life of cell = 50 hours. Cost 2·50 fr. each.

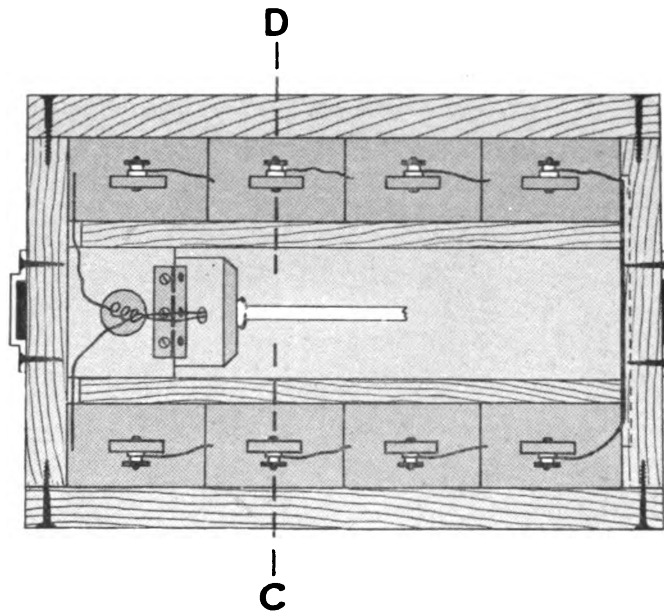
Bulb.—12 volts. One with metal filament and low "amperage" is



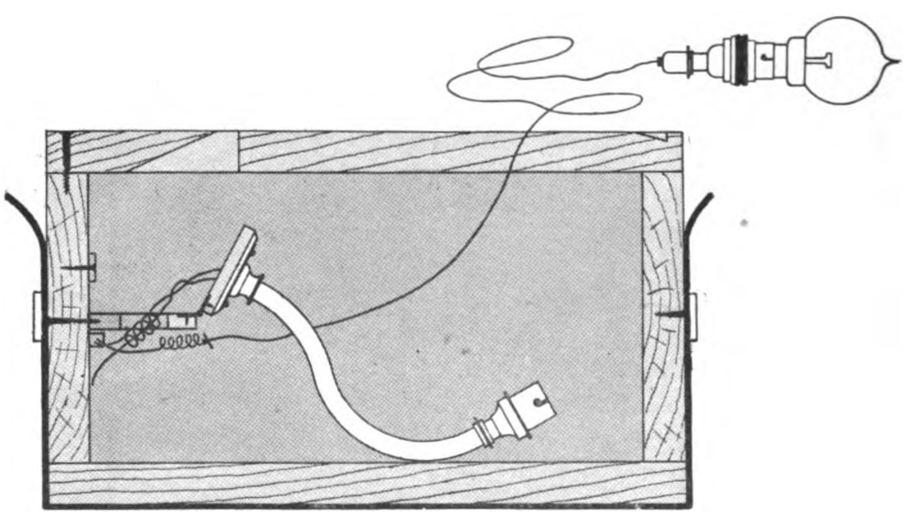
Plan of exterior.



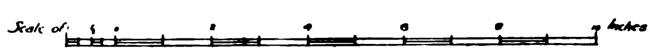
Elevation.



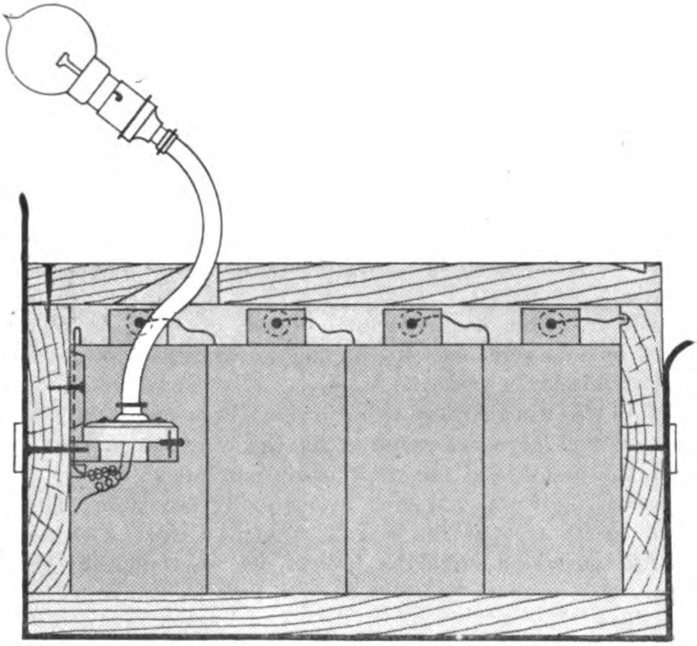
Plan of interior.



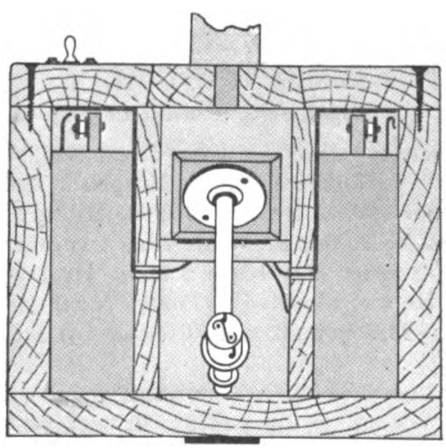
Section A—B.



Scale half full size.



Section A—B with partition removed.



Section C—D.

advisable. Carbon filaments do not stand the concussion of gunfire and shell explosions. When not in use, the bulb is carried in the central compartment.

Lamp-standard is fixed to a hinged block, so that it shuts down into the box when not in use; when in use, fixed by a button.

Flexible Lamp Attachment.—Ordinary twin flexible wire with lamp holder; nine metres of wire is sufficient in most cases.

Switch.—A double switch, one side connected with the lamp standard, the other to the flexible attachment. The inside is wired so that no short circuit can occur.

Weight complete = 20 lb. This could be much reduced by using thinner wood.

Cost.—32 fr. This does not include cost of wood or labour. The cost might be much reduced by buying at wholesale prices at home, instead of at retail war prices.

This lamp was used during operations and was successful; but owing to the number of amperes required by the only lamps that could be purchased, the battery did not work more than twelve hours. But even then, a perfect light was obtained by changing the bulb. The voltage had fallen to 9½ volts at the end of a night's use. The absence of external fittings which could be broken off was found to be a great advantage. One of these boxes was trodden on in the trenches without being damaged.

This pattern of lamp was built at my suggestion by No. 2018 Private W. J. Mills, R.A.M.C.(T.). The excellent scale drawings were prepared by No. 1645 Private H. J. Osborne, R.A.M.C.(T.).

REPORT ON NINE CASES OF SEPTIC WOUNDS TREATED BY EQUAL PARTS OF ICHTHYOL AND GLYCERINE.

By Major C. W. DUGGAN.
Royal Army Medical Corps.

These cases were the most septic out of about eight hundred sick and wounded in the Fourth Northern General Hospital. They were transferred on May 29, 1915, for special treatment at the Military Hospital, Lincoln.

(1) No. 1601 R. T. B., 5th Battalion King's Liverpool Regiment, was wounded at Festubert on May 16 at 2 a.m. He lay till 10 p.m., when he was dressed. He was admitted to Fourth Northern General Hospital on May 19, 1915. The wounds were dressed twice daily with Wright's solution.

On admission, there were three abdominal wounds, extending from the upper part of epigastrium to the pubes; all were septic; the upper one measured 1 inch by ½ inch, the middle 4 inches by 2 inches, and the lower 5 inches across. The wounds were dressed once daily with equal parts of

ichthyol and glycerine; latterly the ichthyol was reduced to 20 per cent. There was no sepsis after the third day. The upper wound healed on June 5, 1915, the middle wound on June 28, 1915, and the lower on July 10, 1915. When first seen, this wound looked hopeless without skin-grafting. The wounds were occasionally touched with sp. vini rect. on cotton-wool.

(2) No. 17687 Private B. J. F., 1st Battalion Suffolk Regiment. Gunshot wound of left thigh, received on May 5 at Ypres. He had been under treatment at the Fourth Northern General Hospital for three weeks with Wright's solution, and fomentations were changed three to six times in the twenty-four hours.

On admission, the wound, which involved the outer and upper part of the left thigh, measured 5½ inches by 5 inches in depth; it did not quite involve the muscle. Equal parts of ichthyol and glycerine were applied once daily. This case also appeared hopeless without skin-grafting. There was no sepsis after the third day. The wound filled up and contracted very rapidly. It healed over on July 14, 1915. The discontinuance of frequent dressing of the wound was very much appreciated by the patient.

(3) No. 7678 Private J. S., 1st Battalion Stafford Regiment. Gunshot wound of back of neck. He was wounded on May 16, 1915. A piece of shell-casing was removed at Boulogne; he was transferred to Fourth Northern General Hospital on May 26, treated with hot fomentations changed thrice in the twenty-four hours.

On admission, there were two wounds in the back of the neck about four inches apart, communicating, and with a drainage-tube extending from one wound to the other. The back of the neck was very much swollen, and the wound was discharging very freely. The drainage-tube was removed on the second day and not replaced. The sinus was syringed out once daily with pure sp. vini rect., and the wounds dressed once daily with equal parts of ichthyol and glycerine. Sinus and wounds had healed completely on the twelfth day.

(4) No. 8812 Private W., 1st Battalion Highland Light Infantry, was wounded at Richebourg on May 16, 1915. He was transferred to the Fourth Northern General Hospital on May 27, 1915. He was treated with fomentations changed twice daily and once during the night.

On admission, there were bullet wounds of left upper arm and left thigh, both septic. The sinuses were syringed out with pure sp. vini rect., and the wounds dressed with equal parts of ichthyol and glycerine. The wounds of the upper arm healed three weeks after admission, and those of the thigh one week later.

(5) No. 6016 Private H., 3rd Battalion Somerset Light Infantry, was wounded in left suprascapular region with shrapnel on May 2, 1915, at Ypres. He was transferred to the Fourth Northern General Hospital on May 8, and the wound dressed with hot fomentations, changed twice daily and once at night.

On admission, the wound was septic, and there was a sinus extending

along left side of neck for six inches containing a drainage-tube. A probe passed along the sinus could be felt immediately under the skin. There was a short sinus on each side connected with the main sinus. The wound was dressed once daily with equal parts of ichthyol and glycerine after the sinus had been syringed out with pure sp. vini rect. On the fourth day the wound was clean; the anterior half of the sinus soon healed up, but a pocket of pus formed half-way along the sinus, and this had to be opened. The drainage-tube was discarded a few days after admission. Had a counter-opening been made at the beginning, the result would have been better.

(6) No. 8135 Private P., 1st Leinster Regiment, was wounded at Ypres on May 11, 1915. His arm was amputated just below the right shoulder-joint for a gunshot wound on May 14. He was transferred to the Fourth Northern General Hospital on May 29, 1915.

On admission, the wound was very septic. There was extensive suppuration along the track of the sutures. The whole stump was very much swollen and exceedingly painful. The various sinuses were syringed out with pure sp. vini rect., and later on with an alcoholic solution of methylene blue (four grains to one ounce), as he complained of irritation from the spirit. The stump was dressed once daily with equal parts of ichthyol and glycerine. In three days it was clean, and on July 7 it had completely healed over, and was about half the original size.

(7) No. 915 Serjeant F. H. J., 3rd Battalion South Lancashire Regiment, was wounded near Hill 60 in the right suprascapular region with a piece of shell on May 9, 1915. This was removed on May 11 at Boulogne, and a large incision was made in the back of the right upper arm on the fourteenth day. He was transferred to the Fourth Northern General Hospital on May 16, and three incisions were made in the forearm on May 20. The wounds were dressed with hot boric fomentations changed three times in the twenty-four hours.

On admission, all the wounds were septic and suppurating freely. The arm was very much swollen and exceedingly tender. His general condition was bad. The various sinuses were syringed out with pure sp. vini rect., and equal parts of ichthyol and glycerine applied once daily to the wounds. On June 19 another incision five inches long was necessary above and behind the elbow-joint, making altogether six wounds. The sinuses closed up quickly, the swelling of the arm subsided, and all the wounds healed completely on July 12.

(8) No. 8699 Private J. S., 3rd Battalion Royal Irish Rifles, was wounded in the left inner ankle by shrapnel on May 3, 1915, at Kemel. He was taken to Boulogne, where the wound was dressed with hot boric fomentations. He was transferred to the Fourth Northern General Hospital on May 8, where three incisions were made in the calf and the wounds were dressed with hot boric fomentations, changed three times in the twenty-four hours.

On admission, the leg was very much swollen and exceedingly tender. All the wounds were septic and suppurating freely. His general condition was extremely bad, as he was suffering from hectic fever due to septic absorption. The wounds were washed with pure sp. vini rect. and dressed once daily with equal parts of ichthyol and glycerine. A fourth incision, six inches long, in the calf was made on June 10, to lay open a fresh collection of pus, and a fifth incision over the outer ankle. The patient's general condition improved rapidly, the wounds soon took on a healing action, and the temperature fell to normal. The back splint which he had on admission is no longer necessary. The wounds healed up by July 12, and the patient is now convalescent. The lower end of the tibia, a small portion of which was necrosed, remains somewhat thickened.

(9) No. 7946 Private J. H., 1st Battalion Scottish Rifles, was wounded on May 12, 1915, at Armentières by a rifle grenade. He was taken to the field ambulance for the night and on the following day sent in a motor-car to the train. He was landed at Dover the next day and transferred to the Fourth Northern General Hospital, where he was found to have a small wound in the upper and outer part of the left thigh. The wound was dressed with hot boric fomentations changed twice daily. It was X-rayed and a bullet located below the great trochanter, close up to outer surface of the femur.

On admission the sinus was septic and suppurating freely. It extended for a distance of three inches down to the femur—no bullet could be felt. The sinus was syringed out with pure sp. vini rect. and equal parts of ichthyol and glycerine applied once daily. On June 10, as there was still suppuration, I enlarged sinus but could feel no bullet, only some necrosed bone on the anterior surface of the femur. The sinus was packed with antiseptic gauze, and the effect was rather disastrous, as although on the following day the gauze was removed and not again replaced, the whole lower extremity began to swell and the temperature went up. Some necrosis of the lips of wound occurred, and matters were brought to a crisis by the use of peroxide of hydrogen. I had to perform an emergency operation at 7.30 p.m. on July 1. The incision was made over the sinus and embraced fully two-thirds of the thigh. Several pieces of necrosed bone were removed, but no bullet could be felt after careful examination. On July 3 the temperature had fallen from 103·6° F. to normal and has remained so. The necrosis of the lips of wound appeared to melt away after two applications of ichthyol and glycerine. Its action on this diseased tissue was little short of marvellous, and in three days there was a healthy granulating surface, the discharge from the sinus closed, and on July 13 the wound had almost entirely healed over. This was the only case in which I considered it advisable to dress the wound twice daily.

The results obtained by the treatment of septic wounds with equal

parts of ichthyol and glycerine are infinitely better than any other method. Several years ago I used pure ichthyol in a case of ulceration of the leg which resisted every other means of treatment—even a fifty per cent ointment of ichthyol aggravated the condition, and I now advocate combination with glycerine, as it is a more satisfactory base than lanoline or vaseline, and lessens the expense. Twenty per cent ichthyol in glycerine is sufficiently strong when the wound has taken on a healing action. I only change the dressing once in twenty-four hours, twice in very exceptional cases. There is thus a considerable saving in the amount of cotton-wool, lint, etc., used. The patient is no longer disturbed by frequent changing of the dressing, and the time in hospital is reduced to half or even less than is the case with other methods of treatment. I paint the ichthyol on boric lint by means of a camel-hair brush and then apply it. It does not irritate the wound; the lint, as it does not adhere, can be readily removed, and a healthy granulating surface results in three days. I avoid washing the wound with lotion, and use instead pure sp. vini rect. applied once or twice weekly. I have almost discarded drainage-tubes. The results are better without them and the patients always experience great relief when their use has been discontinued. I syringe out the sinuses with pure sp. vini recti. In some cases where the patients have complained of irritation after the sinus had been syringed out with spirit I used an alcoholic solution of methylene blue (four grains to one ounce) with very good effect.

SECONDARY HÆMORRHAGE AND PEROXIDE OF HYDROGEN.

By Major CARLINE.
Royal Army Medical Corps.

A patient was admitted to Ward 2A, on May 31, 1915, with gunshot wound in the buttock. On June 11, Captain Purves opened up and drained the wound. On June 28, he was transferred to the Convalescent Home at Woodhall Spa. On July 15, patient had some hæmorrhage followed by a more severe loss during the night. On July 16, the patient presented the appearance of having lost much blood. He was stated to have a copious discharge of pus from deep down in the left buttock, and this had been treated by injections of peroxide of hydrogen.

An incision was made which passed through the narrow opening of the sinus, which soon widened out, and the finger was at once passed into the great sciatic foramen, the gluteal muscles being much wasted and destroyed; the gluteal artery was felt to be pulsating on the edge of the sciatic notch, and with some difficulty secured in forceps, the vessel being in a friable condition. Five pairs of forceps were used before the hæmorrhage was completely stopped; these were left in situ, the wound being

plugged. The vessel was entirely under control of the finger, but the blood which escaped when this was temporarily removed to see if the forceps were properly applied was noticed to effervesce freely, showing that some peroxide remained in the deeper parts beyond the foramen through which the abscess cavity extended. The forceps in course of time came away and the patient returned to this hospital on July 22. There has been no return of hæmorrhage.

Thinking this case over in conjunction with many others, one could not help suspecting that in the presence of a wounded vessel the peroxide, through its action on blood-clot, was sometimes the cause of secondary hæmorrhage, and investigation of other cases tends to confirm this.

In the case of a patient admitted to Ward 2A, March 19, 1915, with a gunshot wound in front of the thigh and a large purulent cavity, which was opened up and drained April 16, peroxide was freely used; on April 25, the patient had a severe hæmorrhage, followed by occlusion of the vessel lower down, with signs of commencing gangrene of the foot, which, however, happily passed away. The conclusion seems obvious in this case that an artery was wounded at the time of injury, probably close to its origin from the femoral, and clot had formed. This, being loosened by the peroxide, had passed into the circulation and blocked that vessel lower down, leaving the originally wounded artery to bleed.

These cases of secondary hæmorrhage were more frequent at the time when peroxide of hydrogen was being more freely used than they are at present. It has been suggested that these cases of secondary hæmorrhage are due to septic infection; probably they are indirectly, if the septic infection has determined the use of peroxide, but having had a large hospital experience of septic wounds from 1867 to 1878, one cannot recall any such cases. At that time, in amputations, the vessels were secured by waxed thread, one end of which was left hanging out of the wound, that from the principal artery being knotted. After a few days these threads were gently pulled upon daily, until they all came away; that on the main artery was not touched until a definite date, which in the case of the femoral was the tenth day, and, of course, in a very septic case these threads would be liable to come away more easily and before their time, and there is no doubt this was the cause of many cases of secondary hæmorrhage.

Cases of secondary hæmorrhage of another kind have been frequent, notably in the calf of the leg, when the tibials have been torn, and in the arm, where a projectile has passed through the axilla perhaps to the elbow, and just beneath the skin. These cases have been found to contain large masses of more or less organized blood-clot, and it has been very difficult to find the bleeding points, which frequently take the forms of one or more slits in the direction of the course of the vessel. In one case the axillary artery was slit for three inches.

One cannot help thinking that the difficulty in these cases would have

been very much lessened and the hæmorrhage, where a vessel is torn across, sometimes prevented, if the art of bandaging the naked limb had not been lost when antiseptic surgery first became general.

FLY PREVENTION MEASURES.

By Captain P. J. MARETT.
Royal Army Medical Corps.

A short account of the measures undertaken for the reduction of *Musca domestica* in manure-heaps in camps and in billets in Rouen may be useful at the present time. Details are given, for attention to what appear to be minutiæ is the secret of success.

It is unnecessary to describe the life-history of the house-fly, and only special points elucidating the processes undertaken with a view to fly reduction will be mentioned.

Manure-heaps.—Adult pregnant flies lay their eggs in clusters; the clustering is readily recognized, and occurs in fresh manure as a rule, but will also occur in stale manure freshly turned over. The clusters occur in cracks in the manure and consist of hundreds of flies, sometimes so many that on more than one occasion flies have been seen leaving a cluster (having laid eggs) carrying one or more eggs on their backs. Clustering is always to be found in a sheltered spot, preferably facing the sun and in places which have been trodden on. Where flies are seen clustering they are not disturbed, but the clusters are marked with a stick, and when oviposition is completed the eggs are lifted and burnt. A trained man removes thirty to forty batches in a day, which practically means dealing with the egg supply of the day. These eggs have to be removed the day of laying, as in summer time the eggs hatch out in a few hours (four to eight).

Passing from the egg to the larval stage, for the purpose of this paper the larval instars will be dealt with as consisting of two only: the first the feeding larva, the second the larva about to transform into the pupa. This division is made owing to the different habits of the two stages.

The first stage is passed in the manure on which the larva feeds. Owing to fermentation and the heat arising therefrom, it is only the upper two or three inches of manure which are suitable for feeding larvæ. A study of this stage of the insect shows that it does not migrate to any extent; as eggs are laid in clusters, so the feeding larvæ are to be found in accumulations, known as nests. Where feeding larvæ exist in large numbers the manure is absolutely triturated, and search for these larvæ is facilitated by recognizing these triturated patches.

During this feeding stage there is no known method of trapping, owing to the fact that horse manure is the natural food supply. On

completion of feeding the larva ceases to grow, and then it begins its second stage; this is the true migratory life, where its only aim is to find a suitable place in which the pupal stage can be passed. Manure is no longer suitable unless it has ceased fermenting. The larval movements have been studied and are found to be carried out at night and on the surface. This is the creamy stage, so called owing to the colour, the larva having voided the contents of its intestinal tract, food no longer being necessary. The larvæ are seen on the surface of the manure making, apparently by instinct, for a suitable site. This must be such as to retain sufficient moisture to keep the pupa from being desiccated, and it must be comparatively cool. Such a site is to be found in the earth on which the mound is placed, or in any hay or straw lying on the surface and which is not fermenting, or else in the old, cold portions of the manure-heap. Pupæ are to be found in such places in enormous numbers. Incidentally it may here be stated that in the natural traps many pupæ are killed off by a fungus, presumably the *Empusa muscæ domesticæ*. With this knowledge, Nature has been imitated, and traps are placed to catch larvæ in the "creamy" stage.

The following is a description of the trap and the manner in which it is used.

Square ration tins are used; these have slits made in all four sides at a level of about two inches from the bottom; the slits are kept open by means of a pebble placed inside, so that the upper edge overhangs the lower; the tins are then filled with about four inches of sand or chaff, and are embedded in the manure so that the slits are on a level with the surface of the manure. On wet nights the tops of these tins have to be covered over. In one such trap over 5,000 larvæ have been caught in a night.

Method of Laying Traps.—It is understood that the manure is dumped at a heap; the face which is not being dumped against must be well trimmed off and a drain channel cut along the face; the earth from the drain must be thrown away from the heap and not on to it. Traps are placed along the edges of the mound at an interval of about three to four feet. As the heap is added to, the line of traps is advanced so as to keep the old manure isolated from the fresh. Where this method is taken into use on an old mound, the line at which the traps should be placed is worked out as follows:—

Starting from the fresh manure, this is turned over to find feeding larvæ; similarly the old manure is searched for pupæ. This portion of the heap has to be shut off from the fresh manure, so that the traps have to be put as close to the fresh manure as possible, at a point well within the places where the pupæ are to be found. By the use of these traps a heap can be kept free of creamy-stage larvæ. The chaff with larvæ is burnt daily.

Formalin solution is used to deal with adult flies on manure-

heaps. The strength of this solution is 1 in 40 of the 40 per cent. solution, to which is added "Ghurr," a native raw sugar ration somewhat similar to molasses. The solution is placed on the heaps in inverted tins, with pieces of bread soaked in it. These traps work excellently on calm dry days, but are not of much use in wet weather. The reason for this is the anatomy of the mouth-parts of the housefly, which is such that all food has to be sucked up through a tube in the form of a solution. Water, therefore, is essential to the life of the housefly, and the drier the surroundings, the better the result from the formalin. On windy days the tins must be placed in sheltered positions at the sides of the manure-heaps.

On wet, cold days the insect is too numbed to fly, and crawls about on the surface of the manure, from which it apparently gets both its moisture and nourishment. What the food is cannot be stated, as sugars are stated not to be found in horse-dung.

The supervision of the above-mentioned operations can be carried out by one man, and the following brief recapitulation gives an idea of the results obtained:—

(1) Marking clusters and removing eggs: maximum number destroyed in a day, 40 clusters; estimated number of eggs per cluster, 2,000; total, 80,000 eggs destroyed per day.

(2) Larvæ traps—60 traps: maximum count for one trap over 5,000; average estimate per trap, 2,500, equals total 150,000 larvæ caught per day.

(3) Formalin traps for flies—60 traps: a rough estimate for flies feeding off each trap 100, a total of 6,000 flies killed daily.

From the above it is seen that about two hundred and thirty-six thousand of all stages are destroyed per day, roughly, a quarter of a million are got rid of by the exertions of one trained man. When a manure-heap is dead the sides are sown with oats and hayseeds, the top being planted with marrows and flower-seeds obtained as a gift from Messrs. Carter and Sons.

Incineration of manure is being carried out with satisfactory results at another unit. The incinerators used are locally known as "bedsteads." Large-meshed wire netting, as used for reinforcing concrete, is placed on iron bars supported on cresol drums. Simplicity and ease of erection are aimed at.

In the incineration of manure two main difficulties have to be surmounted: the one the removal of ash and the other the prevention of condensation of moisture; both are overcome by using this type of incinerator. The incinerators are put up on top of the manure-heap, where they are exposed to the wind; they are arranged in a circle, the inner side of which has a narrow-gauge tramline, by which the manure is brought down from the stables to the dump to feed the incinerators. The bedsteads are covered with the drier portions of litter, and manure

is placed on the top; fires are started with old sacks soaked in paraffin, which are applied to the face or faces exposed to the wind, and a ridge of burning manure is thus obtained. Once the fires are started the incinerators should be loaded up to a depth of two to two and a half feet. The side of the incinerator away from the wind has a piece of corrugated iron put against it, to cause the air current to pass up through the burning manure.

Ashes are removed from the fire by hitting the under surface of the incinerator; they are then raked away and thrown on the side of the mound.

The condensation of moisture is avoided by not loading to a greater height than that already indicated, otherwise the upper layers of manure will be rendered sodden. Once an incinerator is burning well, it is found to burn through in different parts; these holes have to be filled in, otherwise the fire burns out. A fire once started can go on indefinitely. To this method the chief objections are the amount of labour required and the amount of material used for the "bedsteads." As with other manure-heaps, the numbers of adult flies is kept down by the two and a half per cent formalin traps.

Methods Employed in Camps and Billets.

Here the only stage which has to be dealt with is the adult fly. Breeding does not occur owing to the fact that all refuse and excreta are removed and burned daily.

Methods used generally in camps consist in attention being given to the following points:—

Kitchens.—Wire gauze is applied to all windows; this is not done to doors, so that cookhouses are in no wise fly-proof; where flies are a nuisance the use of chicks to windows and doors reduces them enormously and is much better than wire gauze, as flies object to darkness. All cookhouses and dining rooms are furnished with balloon wire fly-traps, baited with jam or sugar in solution; the best bait is stale beer and sugar, and a bait which is now being tried is equal parts of cheese and sugar made into a paste with water. Plates with the formalin solution are placed on brackets, and each has a piece of bread placed in it. Sticky fly-papers are not issued, and a formula for making this mixture was obtained from Lieutenant R. R. Newstead, of the Entomological Commission, and is as follows: Five parts of castor oil and eight parts of resin, the mixture being well boiled. This is issued either spread on paper or in tins, and the units see to the spreading.

Cookhouses are sprayed out weekly with two ounces to the gallon formalin solution, and in those billets where flies are numerous spraying is carried out two or three times a week and also at night. For this work fly brigades have been at work, consisting of a non-commissioned officer and four men; the work required of them is seen from the accompanying

form. No fly counts are made, and the expressions "numerous" or "not numerous" are the indication as to whether a billet requires more than the usual spraying.

The remaining places where precautions are taken are meat stores, food stores, dining rooms, latrines and incinerators. In all these places formalin solution is placed.

Protection of foodstuffs is carried out as thoroughly as possible, but as this paper is an account of measures taken for the reduction of the house-fly, this subject will not be further referred to.

UNIT____________ FOR MONTH OF____________

ADDRESS____________ COMPILED BY____________

1 Date of inspection	2 Condition of meat safe: scrubbed, clean, food only	3 State of kitchen: if clear of clothing or boxes	4 Position of meat safe: in passage, out of sun
5 Number of plates containing formalin, and position	6 Number of windows and panes	7 Size of panes (exactly)	8 Wall-paper, walls or white-washed
9 Refuse bins: number and if properly covered	10 If lids of refuse bins are smeared inside	11 If sufficient provision for covering *all* foodstuff	12 If drain gully is cleaned and paraffined
13 Windows and doors paraffined	14 Number of flies in cookhouse: numerous or not	15 Type and state of latrines	16 Number of flies in latrines: numerous or not

WOUND BY A TRENCH BOMB.

By Major B. W. HOGARTH.
Royal Army Medical Corps.

Corporal ——, Royal Munster Fusiliers, was admitted on the evening of July 17; he had been wounded by a trench bomb the same afternoon. The pyloric half of the stomach, part of the transverse colon and great omentum extruded from the abdomen, the whole forming a mass the size of a Jaffa orange. There was a wound near the lesser curvature of the stomach, close to the lesser omentum, from which oozed dark coffee-ground-looking liquid. He had a deep wound in the right mid-axillary line close to the border of the ribs. He was suffering severely from shock. The piece of bomb had apparently traversed the abdomen, and the injuries appeared to be mortal. He was given morphine, and the viscera were covered with cyanide gauze and he was then watched till morning.

In the morning he had rallied considerably; he was then given an anæsthetic, the skin and extruded stomach were thoroughly cleansed with normal salt solution, the hole in the stomach was closed with two layers of sutures, and the wound in the abdominal wall then enlarged upwards, when the stomach, which had previously been tightly gripped by the abdominal wall, was easily returned. As a part of the abdominal wound the size of a penny was missing and the edges of the opening were necrosed, the stomach was retained in place by gauze wrung out in salt solution, and the wound closed as far as possible. The wound in the axillary line was found not to penetrate the abdominal cavity. He was put back to bed, and saline solution, *per rectum*, was given in abundance. His condition next day was all that could be reasonably desired; the state of the dressing showed that the peritoneum was excreting fluid rapidly.

In the afternoon he was removed to a casualty clearing station, as heavy shells had been falling near the field ambulance station all the morning.

His further progress is recorded by Lieutenant-Colonel T. C. English, in a letter to me, from which I quote: "He did excellently and was evacuated July 29. The only possible trouble was that he vomited a large quantity on one occasion before he left, and it occurred to me that he might be getting some pyloric obstruction."

This is far from surprising when one considers that the stomach had one half of its peritoneum in a state of plastic inflammation and would readily glue itself on to the neighbouring organs, and thus give rise to immobility of the pyloric end. Whether the stomach will free itself or require a short-circuiting operation time will decide.

The case shows that wounds of the upper abdomen are never to be despaired of, and the sooner they receive radical treatment the better.

THE EAU COURANTE HYPER-THERMAL BATH, USED FOR GUNSHOT AND OTHER INJURIES OF THE LIMBS AT THE HÔPITAL COMPLÉMENTAIRE AT THE GRAND PALAIS, PARIS.

By R. FORTESCUE FOX, M.D., M.R.C.P.

EARLY in the present year the Grand Palais was converted into a hospital for the physical treatment of sick and wounded soldiers, among whom a very large proportion suffer from disabled limbs. The hospital includes many separate departments, all under skilled medical direction, for baths, electricity, massage, movements (by hand and apparatus), radiology, etc. Shortly before the writer's visit in July, an annexe was opened, in which similar methods are employed, for out-patients only, drawn from the various military hospitals and homes for officers and men in Paris.

Considerable experience has now been gained as to the action of physical remedies, both alone and in combination. For stiff and disabled joints and muscles the best results are obtained at the Grand Palais by a *combined treatment.* The limb is submitted first to the bath and then to massage and movements.

Importance is attached to the preliminary hydrological treatment. It may take various forms, but the favourite method is the local hyper-thermal bath under the name *Eau courante.* The object of the *Eau courante* apparatus is to subject the injured limb to high temperature and moisture and continuous movement in a circular current of water. The motion may be that of a gentle stream or of a miniature whirlpool. The temperature is kept at the same point during the continuance of the bath by adjusting the valve at the mixer, but for additional accuracy a second thermometer is kept in the bath itself. The degree of heat may vary from 40° C. to 50° C. (104° F. to 122° F.) according to prescription, but the bath is usually given as hot as it can be conveniently borne. The immersion is usually for fifteen or twenty minutes daily.

It is claimed that the *Eau courante* produces an effect quite different from that of still water at the same temperature, or of any ordinary douche or of the familiar electric radiation and hot-air baths. The circulation in arteries, capillaries, veins, lymphatics, is powerfully stimulated and there is great vaso-dilatation, but the effect on the nerve-endings is sedative. In a large number of cases, where, after closure of wounds, pain, swelling and stiffness persist ("gonflement" and "anchylose" of the French), it has been found that pain has been alleviated, swelling reduced, and mobility restored more effectually by the *Eau courante* than by any other means. Consequently it greatly facilitates the mobilization of limbs either by the hand or by apparatus.

Two local baths are used, one for the upper and one for the lower

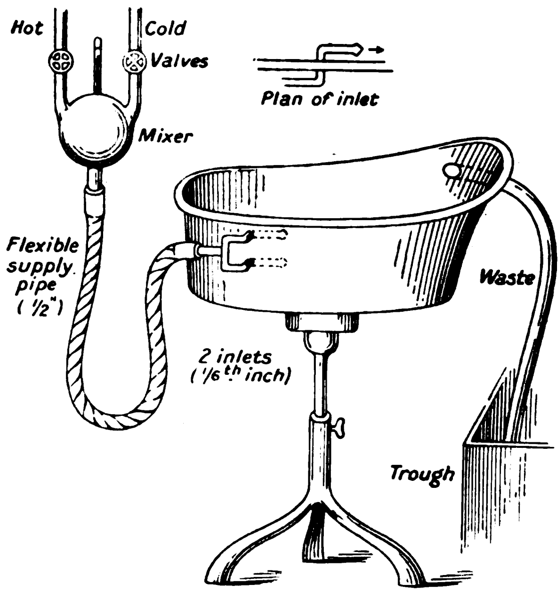

Hot
Cold
Valves
Plan of inlet
Mixer
Flexible supply pipe (1/2")
Waste
2 inlets (1/6th inch)
Trough

FIG. 1.

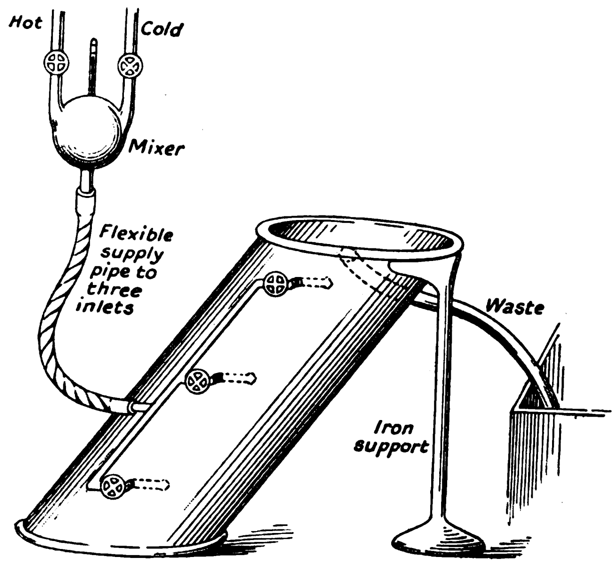

Hot
Cold
Mixer
Flexible supply pipe to three inlets
Waste
Iron support

FIG. 2.

limb; the former treating hands, forearms, elbows; the latter feet, legs and knees. The first is essentially a trough (fig. 1) about two feet in length, held in an iron frame upon a stand with vertical movement and a ball-and-socket joint, so as to raise and rotate or incline the bath in any direction. Hot and cold water meet in the mixer and pass by a flexible supply pipe to two inlets. These are bent at right angles within the bath, so that the entering jets of water are nearly parallel to its side. The overflow from the rotatory current passes away in a flexible waste. The leg bath has three inlets, one, two, or all of which may be used (fig. 2).

In the four months that have elapsed since the writer's visit, the good results then reported have been more than confirmed. This simple but scientific bath treatment is believed to have saved many hundreds of limbs from permanent disablement, and, incidently, saved the Government from a corresponding expenditure upon disabled men. Of course, much depends on the skill and precision with which it is employed and combined with appropriate movements. The daily treatments at the Grand Palais alone are now stated to be as follows: "Hydrotherapy by Eau courante, 400; masso-therapy and mechano-therapy, 800; gymno-therapy and electro-therapy, 500."

Translation.

A COMPASS FOR LOCALIZING BULLETS.

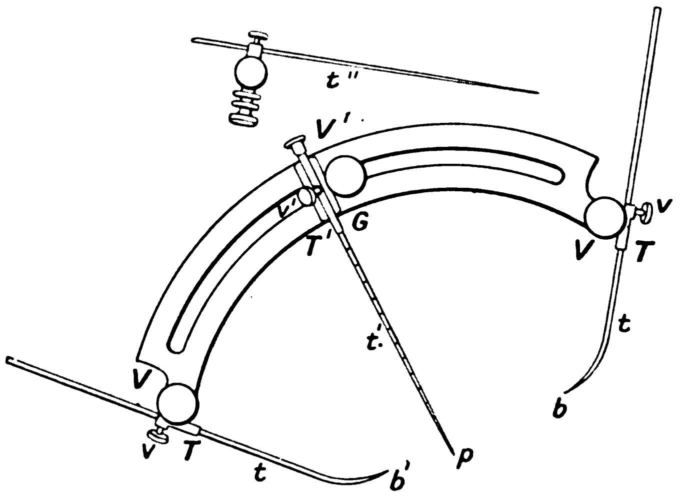
By Professor DEBIERNE.

In the *Presse Médicale* of March 4, 1915, I described a method of localizing bullets, which consisted in determining two axes passing through the foreign body, by means of points marked on the surface of the body of the patient, and in fixing the position of the bullet by the point of intersection of these two axes.

The compass which I have the honour of bringing before the Academy of Medicine enables one to determine actually in the patient's body the direction and depth of the bullet, and thus guides the surgeon who is about to extract it. The compass has been designed by M. Drault, instrument maker in Paris, on the following lines:—

A metallic band, in shape a segment of a circle, is fitted at each end with an attachment which can rotate round a vertical axis, and can be fixed by means of clamp-screw, V, V (fig. 1). Upon these attachments are mounted tubes, T, T, in which slide, with moderate friction, two rods, t, t, curved and pointed at their inner ends. The position of these rods can be fixed by means of clamp-screws, v, v. Thus it is

possible to move these rods, t, t, and to superimpose their extremities upon any given points, for example, over the extremities of one of the axes passing through the bullet. In the arc, the middle part of which is slotted, is a movable attachment, G, which carries first a tongue, l, which, as it fits the aperture, ensures the movement of an attachment being strictly along the arc; and secondly a tube T′, in which can slide with moderate friction, a rod, t′, terminating at one end in a fine point and at the other in a milled knob, by means of which the rod can be moved along the direction of a radius. This rod is graduated in divisions of five millimetres each, the zero point corresponding to the base of the milled knob: in other words, when the rod is pressed fully



home the reading is *nil*. The attachment G and the rod t′ can also be fixed in any position by means of clamp-screws. It is clear, then, that whatever be the position of G, the point of the rod t′ will always be upon the bullet if the ends of the rods t, t, are adjusted to the extremities of one of the axes passing through that bullet; moreover, the direction of the rod t′ will always be that of a straight line passing through the bullet in whatever plane the compass is held, provided that the points of the rods t, t, are not displaced.

In order to make use of the compass, then, all that is necessary is to adjust the rod t′ on the diagram which has been made to locate[1] the foreign body, so that its extremity corresponds with the point p, marking the position of the bullet, and then to adjust the points of the rods t, t,

[1] *Pour le repérage du.*

over the extremities of one of the axes b, b′. Now if the compass is applied to the body of the patient so that the points of the rods t, t, coincide with the points B, B′, marked on his skin, the amount by which it is necessary to withdraw the rod t′ so that its point just touches the skin, gives by direct reading of the divisions on the rod the depth of the bullet in the direction in which the rod points; such a direction is chosen as will give the optimum position from which to make the exploration.

Moreover, in order better to fix the position of the compass, the surgeon can add a second rod t″ on the arc and adjust it so that its point rests upon a spot marked on the skin in a convenient position, so that the extremities of the rods t, t, are always over the points B, B′. The rod t′ is thus supported by a tripod and is in a fixed position.

I may add that all the parts of the compass are nickled and are therefore capable of perfect sterilization.

Reviews.

NERVE INJURIES AND SHOCK. By Captain Wilfred Harris, R.A.M.C.(T.). London: Henry Frowde, and Hodder and Stoughton, 1915. Pp. 123. Price 3s. 6d. net.

This little book is one of a series of short War Primers. It is divided into two parts, the first part being devoted to the direct effects of injuries of the nervous system, the second part to nervous shock following cerebral injury. As the primer consists only of one hundred and twenty-three small pages, the study of such interesting and important subjects as injuries of the brain and cranial nerves, of the spinal cord, of the brachial plexus and of the nerves of the lower limbs, is necessarily short. The reading of the text would have been made more useful by the insertion of a few figures or diagrams in illustration of the areas of the sensory paralyses.

As the author states in his preface that an outstanding feature of the casualties in the present War is the very large number of cases of nervous exhaustion, neurasthenia and functional paralyses of various kinds, the reader turns to the second part with interest for an account of the author's personal experience of these cases. It is disappointing, therefore, to find only some three or four pages devoted to this subject.

THE STRETCHER-BEARER: a companion to the R.A.M.C. Training Book, illustrating the stretcher-bearer drill and the handling and carrying of wounded, by Georges M. Dupuy, M.D. London: Henry Frowde, Oxford University Press, and Hodder and Stoughton. Pp. xi + 138. Price 2s. net.

This little book consists of a series of photographs illustrating squads of four and six stretcher-bearers performing the principal movements of stretcher drill, and also some illustrations of bandaging, hand seats, and a short note on gas poisoning.

The photographs are good and should serve the purpose for which they are intended, but we cannot appreciate the necessity for such a book as this.

The note on gas poisoning is not up to date, and is too sketchy to be of any value. The following errors occur in the book :—

Fig. 3 : The word of command should be : "At the halt—Left Form," and the dotted lines should be straight, not curved as illustrated.

Fig. 58: The modern trench is so deep that the method illustrated is of no practical value.

Figs. 95 and 96: The method shown is not a good form of first aid for fracture of the clavicle, as the elbow is not supported.

Figs. 133 and 134 : The four-handed seat is practically never used at the present time, as the patient can very easily fall off through faintness, and in that case the bearers can give no help, as their hands are used to form the seat.

Figs. 135 and 136: These illustrations represent a very common error in the performance of artificial respiration; the hands of the operator being applied so low that any pressure applied would have very little effect on the capacity of the thorax.

J. P. L.

Current Literature.

Cold-water Treatment for Cholera (Leopold Katscher, Bad Razaz).—Nothing is said about pathology or prophylaxis; treatment alone is the subject of discussion.

The difficulty of treatment by drugs is this—the stomach rejects them before they have time to take effect. Physical treatment is, therefore, the only remedy. In 1839 Frohmann treated with water 500 cholera patients, Lager at Stettin, 80; in 1849, Priesznitz, near Grafenberg, about 130. Hardly any cases so treated proved fatal. At the same time under ordinary treatment two-thirds of the cholera patients died. In 1866 a doctor in Brest Litovsk saved most of his patients by giving them ice to swallow. In a Turkish cholera epidemic Hussein Bey saved hundreds by pouring a bucket of cold water over them when in the stage of collapse.

Winternitz states that hydrotherapy reduced the mortality of the French and German armies (presumably in 1870) from *typhoid* from 27 to 36 per cent down to 9 per cent, or when exclusively employed down to 2 to 3 per cent. It, therefore, deserves notice now.

The advantage of water treatment is that a doctor is not essential. Any nurse with proper instruction can employ it, all the more so as an important part of it consists merely of fresh air; for instance, at Varna, in the Crimean War, 26 per cent of cholera cases treated in tents were fatal, in hospitals 60 per cent. In Constantinople, one month later, this disease was quickly stopped by the removal of patients from hospitals to tents. Half the battle is to get rid of the intestinal paralysis produced by cholera, to stimulate the nerves, increase the activity

of the heart and of the intestinal vessels, to fill with blood vessels antagonistic to or in reflex relationship with the intestines. Cold, suitably brought to bear on the surface of the skin, can alone produce the desired effect. It has been proved over and over again that the most obstinate cases of diarrhœa, treated for years with drugs in vain, have been cured by rational hydrotherapy. "The stimulus of cold must be aided by strong mechanical stimulus exercised on those portions of the skin which are in reflex relationship with the intestines. This will produce not only an increase of the 'entire innervation,' and a strengthening of the activity of the heart, but it will stimulate and brace the intestinal vessels, and by enlargement of the vessels of the skin will afford relief to the blood-suffused organs of the stomach" (Winternitz on Diarrhœa). Obviously what is good for severe cases of diarrhœa is useful also for choleraic diarrhœa. This is the simple explanation of the amazing success of the water treatment of cholera.

Now as this treatment is most completely embodied in the practice of Priesznitz, a full account is given of his method.

It is most important that the treatment should begin immediately the disease appears. Loss of time will postpone recovery, or if too great render it impossible. Very important also is it that the person carrying out the treatment, whether doctor, nurse, or attendant, should pay no attention to the cries of the patient, nor consent to relax or postpone treatment in deference to protests based on the hopelessness of his condition. Again, it is necessary closely to observe the symptoms of the attack before deciding upon the procedure required.

A distinction is to be made between symptoms affecting the stomach and convulsions of the limbs which occasionally develop into rigor.

The fever, vomiting and diarrhœa are treated as follows: Envelop the patient from feet to neck in a moist linen cloth or sheet, temperature 54° to 63° F., and rub him vigorously all over with the palm of the hands. Two men, if obtainable, should do this, and continue till the cloth is lukewarm. If the patient can stand up during treatment all the better, if not, he must be laid on a blanket and turned over when required. To catch the frequent evacuations cloths must be arranged and renewed when necessary. (One account adds that for the alleviation of headaches constantly renewed cold water compresses are used.) If some portions of the body grow warm sooner than others, a little water is poured over them and to equalize matters the cooler parts are rubbed with extra vigour. If the feet are convulsively contracted the remedy is extra rubbing. If insufficient rubbers are obtainable, but only in this case, hot-water bottles in moist coverings may be applied.

The rubbing is now either repeated as above, or if the pains are so great that the patient wriggles and squirms, an absolutely cold enema is employed. Anyway, a sitz-bath at 50° to 52° F. (according to Schindler, a pupil of Priesznitz, 54° to 59° F.) should follow, arranged so that the water, when the patient is in the bath, is nine to ten inches deep. If the water is dirtied by evacuations, or if its temperature rises above 56° to 59° F. (according to Schindler 61° to 63° F.) it is changed. To promote vomiting the patient drinks while in the bath quantities of cold water. As soon as he is in the bath a wet cloth is laid over him from the neck downwards covering the feet; the neck, trunk, legs and feet are rubbed by one person, while another, perhaps the patient himself rubs the stomach

beneath the water. The bath is not left until vomiting and diarrhœa have ceased. This occurs usually in half an hour, except in cases of relapse or those taken at an advanced stage. After the patient is dried a wet bandage is placed on his stomach and above that a dry one. He then lies down and, if not too warmly covered, falls into a profound slumber. On waking there ensues either a bath with the chill taken off, 54° to 59° F. (Schindler says 63° to 67° F.), or rubbing at the same temperature and after this a short air bath—fanning at an open window with a linen cloth thrown over head and body. The patient is then dressed and later exercised indoors if unable to go out.

If convulsions continue and the body is of a bluish tint the treatment is repeated until the symptoms abate. Between the rubbings under the wet sheet the patient, wrapped in a blanket, should be dry rubbed for six to eight minutes. Then comes the cold enema, then the bath as described above. The whole treatment is carried out near an open window, and during the intervals the patient must not return to bed but must sit in a chair by the window with the wet cloth on. Fresh water should always be employed, it should never be allowed to stand and get stale. Increases of temperature should always be obtained by the addition of hot water. The convalescent should wear a bandage for some days and eat cold food only, but no meat (Schindler allows lukewarm gruel as well). If he is very weak, he is invigorated by being washed twice or thrice daily all over at 56° to 59°. F. (Schindler 63° to 66° F.) If, after disappearance of the cholera, diarrhœa lingers owing to relaxation of the bowels, these lukewarm washings alternate with cold ones. If two baths are available one has water in it at 56° to 59° F., as above, eight inches deep, and the other is completely filled with cold water. The patient is first placed in the lukewarm bath and well rubbed, then goes into the cold one for as long as he can bear it, and finally returns to the lukewarm bath and is vigorously rubbed till he is warm.

The rubbing technique is important. First the linen cloth on the body must not be creased. Then the pressure of the hands on the body downwards must be very heavy, it must, in fact, be carried through with a swing; but in the upward stroke the hands must glide over the body lightly and without pressure. The rubbing must be continued in this way till the patient is warm and his skin begins to redden. The rubbing begins with one hand for the upper part of the body, throat, breast and belly, and with the other hand for neck, back and buttocks. After twelve to fifteen strokes change to the two shoulder blades, from there down the arms to the fingers, and lastly the legs. If two rubbers are obtainable, one does the upper part of the body, the other the legs. Not every rubber is fit for this very important treatment, but only the most skilled and the strongest.

The enema injections consist of only forty-five to sixty grammes of quite cold water in order to contract the rectum, and by reflex action to check vomiting from the stomach. As for cold water drinking, it is persevered in even after the commencement of vomiting in order to prevent fresh convulsions, as these are caused by the removal of all water from the body owing to diarrhœa.

Schindler says that attendants on cholera cases need not fear infection. The disease, if the cure is promptly applied, is not at all dangerous; its duration is brief, and in most cases the attack is over without after-pains in less than an hour.

The principle of the whole treatment is to help Nature and to regard her as a true physician, to support her efforts with the simplest of remedies and on no account to oppose her. For prophylactic measures the foundation is simplicity and conformity with Nature. Wear stomach bandages, changing them four or five times daily, especially before meals and at bedtime. Wash all over night and morning, avoid hot food and drink, iced drinks and spirits. Eat little meat and not much fruit. Eat and drink little in the morning and take at every meal a large glass of cold water to brace the digestive organs. (Schindler adds: "If good drinking water is unobtainable drink boiled, stood till cold, with the addition of lemon or bilberry juice.") Rub yourself down every morning, take a short bath, three to five minutes, not too warm. Then take half an hour's walk out of doors; no warm baths, windows open day and night. On the slightest feeling of discomfort in the stomach put on a bandage about three yards long, one-third of it to be dipped in cold water, wrung out and applied with the dry part outside. Wear it day and night or only at night in cold weather, renew it when dry (three to four times daily). Thus the only real preventatives are hardening off and dieting. But once the disease breaks out, and in cholera epidemics doctors are so overdriven that they often arrive too late, relations or friends can begin the water treatment without the doctor, for promptitude is the real essential. Considering that cold bandages can check effusion of blood, it is not surprising that they can cure over-evacuation of mucus, and cold enemas are of astonishing efficacy in stopping diarrhœa. Yet ordinary practice recommends the use of warmth, forgetting that its prolonged application causes blood congestion and heart-weakness.

Many object to the use of cold on the ground that the temperature of the body has already fallen below normal, but it has been established by frequent observations that the temperature of the rectum in cholera cases exceeds the normal by two to four degrees, so that the bodily warmth is retained by the internal vessels. Of this fact most doctors appear to be ignorant. By the stimulus of cold not only are evacuations from the stomach checked, but the flow of blood from the mucous membrane of the digestive canal and other internal congestions is stopped. Consequently blood reaches the skin, the whole nervous system is strongly stimulated, and normal activity restored to all nutritive organs, while all cholera symptoms disappear.

Sebastian Kneipp recommends both for cholera and for small-pox, that the patient should be plunged for one or two seconds only into an absolutely cold sitz-bath. He adds that the use of such a sitz-bath prophylactically, once or twice daily, will either prevent cholera altogether or cause it to appear merely as cholerina. Another remedy he suggests is a bandage folded six to eight times, dipped in "hayflower-water" (*sic*). But if genuine cholera supervenes he emphatically advocates the use of heat. Dip a canvas bag in water as hot as the patient can bear (rather rough and ready, remarks Katscher), fold it several times and lay it on the stomach. If in a quarter of an hour or twenty minutes the body is not thoroughly warm, repeat the treatment. When the patient has sweated for an hour the bandage may be removed. If he is free from pain and can lie still, no further application of heat is required, but he should be washed with cold water once, twice, or thrice

daily to fetch the sweat off the skin, invigorate the body, and increase the natural warmth.

Kneipp evidently expects recovery to be a much longer process than Priesznitz, and his advice is not known to have been submitted to any extensive practical test.

Dr. Sadger writes: "I feel impelled to utter an emphatic warning against heat treatment of cholera. Heat is not only useless, but positively harmful. In spite of the natural repugnance of patients, heat, and particularly steam, are constantly employed with pitiable results." Walser says: "The colder the patient is, the colder should the water be if he is to be warmed."

Casper, of Berlin, reports in 1832, that patients struggled frantically against the application of warmth, and that those lying almost inanimate moaned.

Becsey, strongly opposed to Kneipp, pronounces that the main point is to check diarrhœa and vomiting, and that nothing is more reliable, more infallible, than cold water. Begin by massage with a coarse linen cloth dipped in cold water applied with skill and vigour. Then a sitz-bath at 63° F., or less, for fifteen minutes at least. Next cover the patient up warmly and rub his arms and legs hard. Finally apply a properly fitting short cold bandage, put him to bed and cover him up well. This will ordinarily suffice to produce the required reaction, but in severe cases more drastic treatment will be necessary. Lower the temperature of the bath to 50° F. and increase its duration to half an hour. Use powerful needle-baths, a portable fan-shaped douche, a sitz-bath combined with a stomach-douche from a height of five feet. To neglect this treatment, when means allow, would be a grave dereliction of duty.

Casper, mentioned above, placed the patient in a bath filled to the navel with water at 93° F., poured two to five buckets of cold water over head, breast, and back, and vigorously douched breast and belly, repeating the treatment if necessary every two to four hours. Then put him to bed with cold bandages round trunk and head, and feet wrapped in warm blankets. Internally cold water, ice, and cold enemas. Nothing like cold, he says, to rouse lowered vitality. His Viennese contemporary Günther, during the first outbreak of European cholera, washes the body with cold water and rubs it with ice, especially the extremities. In five or six minutes the desired warmth is produced. Then dry the patient and wrap in fairly warm sheets. Internally spring water in sips every two to three minutes, a piece of ice every five to ten. Treatment by drugs at that period obtained 33 per cent of cures, Casper and Günther about 66 per cent. But as Priesznitz reached 100 per cent and Schindler nearly the same figure, it is not hard to decide on the right treatment nor to agree with Dietl in stating that of dangerous diseases cholera is one of the most easily curable, if Priesznitz's treatment is followed.

Professor Wilhelm Winternitz, of Vienna, follows the instructions of his teacher Schindler with a few differences of detail. As a precaution massage all over every morning with a cloth dipped in water at 50° to 64° F. For stomachic disturbances a Priesznitz body-bandage. The slightest diarrhœa to be treated with cold water; after a complete rub down, without drying, fifteen to thirty minutes in a sitz-bath at 50° to 54° F., then body-bandage and much water-drinking. If desirable the

precautionary massage could be replaced by a douche or hip-bath, the diarrhœa massage by an all-round needle-bath or a stomach fan douche. Another important point. The after-pains, which follow pharmaceutical treatment, are absent under the water cure. But if pain should occur use daily two to three hip-baths at 77°, 73°, 68° F., according to the severity of the symptoms, together with plenty of water thrown over head and neck and simultaneous hard rubbing of the legs by a second attendant. The same treatment, only less drastic, is suitable, for cholera nostras, except in the severest cases, when the treatment must be the same as for Asiatic cholera.

When cholera is about pay no attention to all the prophylactic nonsense you will hear on all sides, but live hygienically. Do not even read the official "rules of life," which because of their detailed nature inspire fear. Fear is more likely to bring the infection than all the bacilli. It produces diarrhœa of itself. It diminishes the vigour of health and makes you ill. "In the terrible cholera epidemic at Hamburg, in 1892, many people lost their heads from fear, their will-power was weakened, they sickened and died. I was there myself, did not disinfect, was not in the least afraid, and with wife and daughter remained immune. One day seeing everyone retching, I got downhearted, thought of how many people had died, and how the cholera was still raging. These enervating ideas went on till I began to have a stomach-ache and to feel sick. Perhaps I should have got cholera if I had not succeeded in forcibly driving away my gloomy thoughts by breaking into a song."

Kobilansky, of Lemberg, ascribes the great influence of fear in cholera to the fact that the disease is rather nervous than intestinal, so that auto-suggestion plays a great part by producing agitation of mind, which lessens the resistance power of the nerves. He adduces a classical example of this from the year 1849. A thoroughly healthy criminal condemned to death, was offered his life on condition that he should spend the night in a room where a cholera patient had died the evening before and, as he was carefully told, in the very bed. He did so, but was so panic-stricken that diarrhœa and convulsions resulted, and he succumbed. As a matter of fact, the furniture of the room was quite new and no patient or corpse had ever been there.

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Original Communications.

NOTES ON THE TREATMENT OF DIARRHŒA AND DYSENTERY ISSUED BY THE ADVISORY COMMITTEE FOR THE PREVENTION OF EPIDEMIC DISEASES IN THE MEDITERRANEAN EXPEDITIONARY FORCE.

BY TEMPORARY LIEUTENANT-COLONEL ANDREW BALFOUR, C.M.G.
Royal Army Medical Corps.
Member Advisory Medical Committee; Director-in-Chief, Wellcome Bureau of Scientific Research.

ONE of the best methods of preventing the spread of dysentery and other diarrhœal diseases is the prompt and efficient treatment of cases. The Advisory Medical Committee appointed by the War Office has therefore considered it desirable to issue the following notes on the treatment of dysentery and diarrhœa, for the guidance of those who may not have had much opportunity of handling cases of the various types of dysentery met with on the Gallipoli Peninsula, and in Imbros, Lemnos, and Egypt.

As dysentery of whatever form is usually preceded by an irritative diarrhœa information is also furnished regarding the treatment of this condition.

The treatment of all cases of enteritis may be divided into :—

(*a*) Dietetic.
(*b*) Medicinal.
(*c*) General and prophylactic.

(*a*) DIETETIC.

As the earliest stages of amœbic, bacillary, flagellate, or ciliate dysentery cannot easily be distinguished from a mere irritative diarrhœa, the diet suitable for all these forms may be here considered very briefly.

It should in every instance be liquid and may consist at first of barley water, rice water, oatmeal water, albumen water, or chicken broth if available. Milk is better avoided during the first twenty-four hours. Thereafter it may be administered preferably diluted with water or barley water. It may be given malted or peptonized if the stomach is irritable. In the case of true dysentery it is very desirable to obtain fresh milk if at all possible. It is an advantage to add three grains of citrate of soda to each pint of milk, in order to prevent the formation of large curds. Bicarbonate of soda and sodium chloride may also be used for this purpose.

Alcohol is distinctly deleterious at this stage and should not be exhibited.

No solid food should be given until the active processes in the bowel subside, when arrowroot, custards, etc., should be added with due caution. In the early amœbic form soups are stimulating and often useful. In Egypt the easily assimilable curdled milk known as "laban zebady" will be found valuable in all forms of enteritis. In some cases it is found that throughout the illness milk cannot be tolerated. When this occurs, Benger's food, Brand's essence, bovril, and light soups may be given. In every case it is important to see that the food is neither too hot nor too cold, as otherwise colic is very apt to be set up. For the same reason food should be given in small quantities frequently.

(*b*) MEDICINAL.

(1) *Diarrhœa.*

The following remarks apply not only to simple irritative diarrhœa, but to the early diarrhœal stages of all the forms of dysentery above mentioned.

A case seen right at the beginning should at once be given one ounce of castor oil. If colic is present ten drops of tincture of opium should be added to the oil. This treatment alone, with rest, warmth and suitable dietary will often check the condition. It may frequently with advantage be followed up by one-drachm doses of castor oil in an emulsion given every four or six hours for twenty-

hours. At the same time, having regard to the difficulties in coming to an exact bacteriological diagnosis, emetine should be administered intramuscularly or intracellularly from the outset in the dose already recommended by Sir Ronald Ross, namely, two-thirds of a grain once or twice a day.

In severe cases which show every sign (colic, tenesmus, rise of temperature) of passing on into a true dysentery there should be no hesitation in giving a larger dose of emetine. As much as 2 or even 3 grains daily, say in ½-grain doses every four hours, may be administered so long as it is tolerated by the patient. The smaller dose will, however, generally suffice. Intolerance is usually shown by nausea and a tendency to collapse. Salivation may also be present. So far as is at present known there is little or no risk of a cumulative effect.

If the castor oil fails after fair trial it is well to have immediate recourse to the salines. The following prescription is useful:—

℞ Sod. sulphat. ..	..	..	..	gr. lx.
Acid. sulph. aromat.	..	..	..	♏xv.
Tinct. zingiberi	..	..	..	♏viiss.
Aq. menth. pip.	..	..	..	℥i.

It may be given every two, three, or four hours, according to the severity of the case, and should be continued until the stools become watery. Sodium sulphate is on the whole preferable to the magnesium salt.

Note.—It would seem that calomel has not been so successful in the treatment of diarrhœa amongst the troops as the measures above indicated. Opium may be necessary if there is much griping, but is better avoided after the initial dose given along with the castor oil.

(2) *Amœbic Dysentery.*

Acute.—When the bacteriologist pronounces the case to be due to *Entamœba histolytica* infection, or when the symptoms (character of stools, course of the temperature, etc.) point to entamœbæ being the cause, it is necessary to continue the emetine treatment energetically.

A dose of one grain given once or at the most twice a day, and preferably by the needle deep into the outer portion of the forearm after careful skin sterilization is usually ample, but it must be remembered that emetine acts by killing the causative entamœbæ and preventing the formation of their infective cysts, and that emetine alone will not cure the ulcerative colitis which is speedily

established in a case of amœbic dysentery, nor has it any effect upon the secondary septic absorption which so often occurs. Hence to rely wholly on the emetine treatment is in many cases a mistake unless, indeed, it is instituted at the commencement of the illness, when it usually suffices.

Local treatment of the bowel is, therefore, indicated in all save mild and trivial attacks. For this purpose the saline mixture mentioned under diarrhœa should be continued four-hourly at first, and if necessary pressed; while washing out the lower bowel night and morning with a plain warm saline solution, administered by means of a douche can, is very sound and often affords great relief. The saline treatment also washes away amœbic cysts, and by its scouring action on the intestinal epithelium may possibly enable the emetine to act on deep-seated cyst-producing entamœba. Care should be taken that the nozzle used is sterilized after use, as infection has been conveyed by this means. Later on, when blood has disappeared from the stools but mucus still persists, daily enemata of tannin and quinine should be substituted. The lavage must be performed carefully and slowly, and continued until the intestinal effluent returns almost clear.

Dissolve 150 grains of tannin and 15 grains of quinine hydrochloride in a litre ($1\frac{3}{4}$ pints) of warm water. If painful half strength may be employed.

Tannin alone, 0·5 to 1·0 per cent, may be used. Calcium permanganate, 6 grains or more to the pint, is an alternative solution. A sedative enema which may be tried with advantage consists of bismuth 2 drachms, tincture of opium 30 minims, and thin starch 2 ounces. When it can be managed an ounce of linseed soaked for several hours in 2 pints of warm water makes a soothing injection. A suppository of cocaine and morphine will frequently facilitate the administration of enemata and may also benefit spasms and tenesmus.

Sir James Crichton Browne has suggested that hypochlorous acid in the form of injections of "Eusol" is worthy of trial combined with saline lavage. This will soon be generally available and the Committee thinks there are good grounds for adopting the suggestion, though such a line of treatment is perhaps more adapted for chronic cases.

In very severe amœbic dysentery emetine should be given intravenously. As much as one and a half grains can be injected daily dissolved in ten cubic centimetres of saline. Emetine may also be given by the mouth in keratin- or salol-coated pills taken at

night on an empty stomach, but is not so good when thus administered. In all cases diminish the emetine as the case improves. Thus, as a rule, the daily dose can soon be reduced to half a grain. It is well to carry on the treatment for a week or ten days, then to give a week's rest and to start again if examination of the stools shows that a further continuance of the treatment is necessary. Another method is to give the daily dose for a week and throughout the second week to inject the emetine on alternate days. Save for the purpose of getting rid of cysts it is rarely, if ever, necessary to continue the costly emetine treatment beyond a second course. If emetine is going to do good its beneficial action is quickly apparent. It is well to remember that emetine itself may, even in medicinal doses, produce diarrhœa, and, when used in the form of suppositories, is said to have produced bloody stools. Hence, one should always ask oneself if a persistent diarrhœa in a dysentery case taking emetine may not be due to the drug and not to the disease. Failing emetine, recourse must be had to the old ipecacuanha treatment, which Sandwith describes as follows :—

"The patient is starved for four hours, say from 5 p.m.; at 8.45 p.m. a mustard plaster is applied to the epigastrium, the pillows are removed from beneath the patient's head, and 15 minims of laudanum in water are given to him. At 9 p.m. he has one dose of 30 grains of ipecacuanha, and to prevent vomiting he is kept absolutely at rest, the nurse being ordered to wipe his lips to prevent his even swallowing saliva for at least three hours, when he is allowed a small drink. The next night, with similar precautions, he is given 25 grains of the drug, preceded by ten drops of laudanum. On the third night he takes 20 grains after five drops of laudanum. After this opium is no longer required, and the ipecacuanha is gradually reduced to 5 grains and kept there till the course has lasted a fortnight, when the patient will have taken altogether 145 grains. The patients submit willingly to possible vomiting and rigid rest and make up by day for rather sleepless nights."

The form of ipecacuanha containing emetine is, of course, indicated. It is useful to add one part of tannin to three of ipecacuanha. The dose may be divided amongst four cachets, which are taken at the same time and continued daily for three days, then being gradually diminished.

During convalescence salicylate of bismuth should be employed if diarrhœa persists. Some employ bismuth in large doses either as the subnitrate or salicylate along with emetine throughout the

illness, but, so far as recent experience goes, the saline treatment seems to be preferable.

In all severe cases the tendency to heart failure should be remembered, and the value of hypodermic injections of camphor in this condition recalled.

(2) *Chronic.*—Here local treatment is most useful. "Eusol" injections may be tried. So may large enemata of copper sulphate 1 in 1,000, or nitrate of silver with opium and starch. It does not appear necessary to enter fully into this question as but little that is new or specially valuable has lately been advocated.

Note.—In every case of severe advanced amœbic dysentery the stools should, whenever possible, be carefully washed and searched for sloughs, as their presence or absence forms a most useful guide to the course of the disease and may indicate the need of caution in giving injections by the bowel.

(3) *Bacillary Dysentery.*

(1) *Acute.*—When the bacteriologist reports a case to be due to *Bacillus dysenteriæ*, or when the course of the disease (character of stools, course of temperature, etc.) points to invasion by a bacillus of the dysentery group, two lines of treatment have to be considered—that by specific polyvalent serum and that by salines.

Serum is now available and there can be no doubt that in many cases it is of great value. The sooner it is given the better. The dose is twenty cubic centimetres by subcutaneous injection, and as a rule this is sufficient, but if necessary as much as sixty cubic centimetres may be given at the outset, or the above dose may be repeated.

If salines are employed the sodium sulphate mixture mentioned under amœbic dysentery will be found to act well. As a rule it should be combined with simple lavage of the lower bowel.

In very bad cases drained by incessant evacuations, intravenous inoculation of saline on the lines introduced by Rogers for cholera will often save life, *but it must be resorted to in good time.* The special cholera outfit in two separate cases is now available and should be at hand for treating such cases of dysentery. Full directions are supplied with the outfit. An emergency injection consists of common salt 60 grains, carbonate of soda 60 grains, boiled water 1 quart. Give one to three quarts at a temperature of 100° F., carefully watching the effect. The danger of heart failure even at an early stage must be borne in mind.

(2) *Chronic.*—Local treatment similar to that employed in

chronic amœbic dysentery is indicated, and, if available, the organic silver compounds albargin (silver gelatose), 1 in 500, or protargol, 1 in 100, should be accorded a trial. Here, again, "Eusol" may find a useful field.

Enemata of olive oil sometimes prove very useful in this form of dysentery.

Note.—In cases of doubtful etiology there should be no hesitation in employing a combined therapy of emetine and polyvalent serum. In both forms of dysentery colic is benefited by turpentine stupes to the abdomen, while hæmorrhage may be controlled by morphia or adrenalin hypodermically, calcium chloride or lactate by the mouth, or oil of turpentine in capsules.

(4) *Flagellate Dysentery.*

The only form which need here be considered at length is that due to *Trichomonas hominis*, for this is the only form of flagellate diarrhœa or dysentery which has hitherto, so far as is known, been recognized amongst cases occurring in the Mediterranean Expeditionary Force. It cannot be recognized clinically, but may be suspected in cases of persistent diarrhœa with bright yellow stools. In any case, the other forms due to *Lamblia* and *Tetramitus* cannot be very satisfactorily treated.

Trichomoniasis, however, though troublesome, can be dealt with as follows: In the early stages give an enema of an aqueous solution of iodine 1 in 1,000. The water used need not be boiled as the iodine sterilizes it. Administer the injection slowly every evening for three consecutive days, giving one litre at a time. The iodine enema should be preceded by one of boiled water.

If the parasites persist a tablespoonful of the following mixture should be given every two hours for the first three days:—

℞ Infus. cinchonæ (1 in 50, not acid)	℥iiss.
Ext. cinchonæ	ʒiii.
Tinct. cinnamomi	ʒv.
Syrup. opii (0·5 ext. in 1,000)	ʒiii.
Tinct. camph. co.	ʒi.
Olei terebinth.	♏ xlviii.
with	
Gummi acaciæ	ʒss.
Aq. flor. aurant.	ʒss.
Aq. dest.	℥v.
Syrupi	ʒii.

In addition the following enemata night and morning are indicated:—

(a) 3½ pints of decoction of eucalyptus.
(b) 2 ounces of boiled water, yolk of an egg.
10 minims of laudanum.
15 minims of essence of turpentine.

This is Escomel's treatment, the essential of which is the exhibition of turpentine. It may be noted that for lambliasis the same author recommended calomel and aromatic castor oil.

(5) *Ciliate Dysentery.*

Balantidial dysentery has been recorded recently from Egypt. The treatment is unsatisfactory, but thymol may be given, and local treatment with organic silver compounds or tannin enemata tried.. Emetine has also been recommended and used with some success.

(c) General and Prophylactic.

The necessity for absolute rest and warmth to the abdomen, as by means of a light linseed poultice sprinkled with laudanum, need scarcely be insisted upon, but the Committee would again emphasize the value of careful washing of the stools and a search for sloughs. It would also remind medical and sanitary officers that so far as amœbic dysentery is concerned, the post-dysenteric case with formed stools or slight diarrhœa is much more dangerous to the community than the man suffering from acute dysentery. It is in the former that the resistant cysts are found which may infect food, water, dust, and flies, and find their way by one or other of these channels into the human host.

Emetine is apt to fail in the eradication of these cysts, but this is by no means always so. The following measures now employed to protect France from the introduction of amœbic dysentery by convalescents from her Eastern Colonies are worthy of note, and might be followed with advantage.

Four or five grains of emetine hydrochloride are dissolved in tincture of opium in the strength of one in fifteen. Eight to ten drops of this mixture are added to a cup of strong tea and given nightly, emetine hypodermically being reserved for acute cases. Such a measure would seem advisable in the case of men getting ready to leave hospital and in convalescent and rest camps.

General sanitary measures which are of the highest importance, as, for example, the provision of fly-proof and wind-proof box latrines, etc., do not fall within the scope of this memorandum.

It is important to note that emetine has no action on the cysts themselves. It only attacks the entamœba which produce them, and its failure is probably to be attributed to the vegetative forms being in some position where the drug cannot readily get at them. This, however, is only a hypothesis, for our knowledge of the subject is far from complete.

As regards flagellate dysentery, Castellani has recently recommended the use of methylene blue, 2 to 3 grains thrice daily in cachets, combined with intestinal irrigation (1 in 5,000 or 1 in 3,000). In obstinate cases where the treatment has to be carried out over a long period, the drug should be discontinued from time to time, to prevent the formation of methylene blue concretions in the intestines.

SOME EXPERIENCES OF A PRISONER OF WAR IN GERMANY, WITH REMARKS ON FOUR PRISONERS' CAMPS.

By Captain W. K. BEAMAN.
Royal Army Medical Corps.

The writer feels that these experiences may be of interest to readers of this Journal, and that they will be of value in helping them to form a clearer and more correct opinion of the German character.

One of the many things that has struck the writer most forcibly during the past month—that is, since his liberation—is the misconception of the German character displayed by the average Englishman, whether civil or military.

Some fourteen medical officers, all belonging to mobile medical units, were captured on August 26, 1914, at Landrecies, where there had been a fight during the night (25th to 26th). We had formed three hospitals in the town, and were in charge of severely wounded men.

The German officers and men who captured us, and practically all the others who visited us from time to time, were quite polite. They took nothing from us. They were very suspicious and very particular about collecting all the arms of the wounded. One medical officer took some dressings, but returned them later upon the order of a senior officer.

The officers asked few questions, assured us that the British Army was destroyed, and that Paris would fall in a few days.

The town was looted, private houses were broken into, and the furniture wantonly destroyed. There was some difficulty in obtaining supplies for our personnel and wounded.

Most of the local inhabitants had fled, including the doctor and the mayor. At the time one was inclined to blame these people for deserting their posts. In the light of later events one is forced to acknowledge that they were quite right. On the 28th the mayoress returned, and was exceedingly kind and helpful in obtaining supplies for the wounded.

Our Senior Medical Officer now made an official application to the General Officer in Command of the nearest Army Corps for our return either to our own lines or to a neutral country. He was informed that we should be returned, but must first pass through a German base. Orders were given for a move on the morrow (the 29th), and to take with us all wounded capable of travelling.

On the 29th the very severe cases were collected in a school which had been converted into a hospital. Two medical officers and some men were left in charge, the remainder set out for Bavai about 2 p.m. with an escort.

The commander of our escort was a *Feldwebel* (a warrant officer), and was very good on the whole. He saved some of our horses from being taken by passing troops, and carried off a difficult position with much tact and good humour.

The journey was uneventful. We stopped two nights and a day at Bavai to rest the wounded, who were cared for in the French hospital, and then proceeded to Mons.

The feeding of the personnel was difficult, but we were able to obtain a certain amount of bread on requisition and some live pigs. Pork in August cooked before it is cold is not an ideal ration, but was most acceptable under the circumstances. The Mayor of Bavai (long may he live!) gave us a barrel of beer.

We arrived at Mons on the evening of the 31st. Here our treatment completely changed. The column with wounded was marched twice round the town. The local inhabitants were most kind, and gave the men chocolate, cigarettes, cigars, and tobacco, till stopped by the German soldiers. We were finally hustled into a large barrack yard, and were ordered into a large dormitory over the stables, personnel and wounded all together. We were made to wade through stable drainage to reach this haven, the boards which were used to cross it being kicked away by our new guards. No food or water was supplied either to the personnel or the wounded.

Through the kindness of a sentry we were enabled to get some water in our dixies, which we fortunately brought with us. The wounded received a light meal of milk and biscuits supplied from our panniers. This was the last meal many of them received for some time. We did not get much sleep as the place was so dirty.

At 4 a.m. on the 1st we were aroused and ordered to start at 6 a.m., leaving our wounded. One biscuit per man was issued, and we marched to the station under a guard with fixed bayonets. Hitherto our escort had not fixed bayonets. After waiting some two hours in the square we were separated from our transport and interned in a shed in the station yard. We were given no food, nor were we allowed to get food from our transport. All requests, including a request to see the Commandant, were met by insults. We spent a very unpleasant day and were ordered to entrain about

6 p.m. The officers were entrained in a second-class carriage. The personnel and transport were left behind. Before entraining all knives and razors were taken from us.

The journey was uneventful, only marked by the absence of food, until 6 p.m. on the 2nd, when we arrived at Achen.

Here a mob of drunken Uhlans and railway employees were incited by a German officer—a colonel—to take us out of our carriage. He said it was scandalous that we who had gouged out the eyes of German wounded with the marlin spikes of our clasp-knives should travel in a second-class carriage, while German wounded were in trucks. Several of the mob had these English clasp-knives and were threatening to practise upon us, some tried to hit us through the windows, and some were making efforts to get into the corridor, when a younger officer came up and quelled them.

The howl of an angry mob is most unpleasant and terrifying. The writer for one never wishes to hear it again, the song of the shell is far preferable. We were now given a special guard who were very suspicious and stand-offish at first, but rapidly thawed. We owe this guard much, for by their kind offices we obtained some food. The German Red Cross give no food to prisoners, wounded or otherwise. At times it is shown to them and then withdrawn, with kindly remarks that its not for swine.

We were visited by a German officer and complaints were made of our treatment, and a demand made to see the German Commandant or the American Consul at Colne. We were informed that there were various charges against us, and that we should be searched and examined later.

At about 6 a.m. on the 3rd, we arrived at Dortmund, and under a very heavy guard we were marched to the Station Kommandatur. Here our Senior Medical Officer had an interview with the Commandant, who was very polite and accepted our word that all charges of ill-treatment of German wounded were false, and further ordered the Red Cross to give us food. This they did very unwillingly. One lady, when asked if she could speak English replied : "I can, but I won't." After our meal our journey recommenced, but under better conditions. The guard protected us from insults and we were allowed to buy a meal at Kriensen, about 9 p.m., the first meat we had had since Bavai on the 31st. We were given another meal on the morning of the 4th, and arrived at Torgau about 1 p.m., after nearly eighty hours in the train.

Torgau is an old fortress where French prisoners were interned in 1870. The writer has vivid memories of the first night when he

was driven from his bed by bugs. After a dour struggle he capitulated and spent a fairly peaceful night on the floor.

A general outline of conditions at Torgau follows. Torgau is a lager for officers. There were some sixty British officers and some hundreds of French officers already there on our arrival.

Housing.—Officers were housed in soldiers' barrack-rooms. Each had a bed and most of them had a soldier's cupboard. The bed consisted of a straw mattress on boards supported on an iron frame. Bedding consisted of two blankets, one sheet, pillow slip, and blanket bag. The latter acted as a second sheet. Linen was changed monthly. Later, when prisoners became more numerous, huts were put up and the junior officers were housed in these. Here they had no cupboards and very little furniture. The rooms were warmed by stoves.

Messing.—There was a small kitchen and a very small and dirty canteen. At first the kitchen was managed by a staff of German women. Later it was taken over by the French who managed all the messing. Food was bad but cheap. One could buy extras such as jam, ham and sausage at the canteen. With extras one lived on between 2 marks and 2 marks 50 pf. per day.

We were formed into messes of twelve to sixteen and dined in the corridors. One large dining-hall was erected but was insufficient to hold all and was used by the French. We had to buy all our own cutlery and crockery. The kitchen was much too small to cook for 1,100 officers.

Latrines.—We used the same latrines as the German Guard. Extra ones were built later. They were very dirty and only cleaned out when absolutely necessary — urinals were usually allowed to overflow.

Ablution.—There was a good system of shower-baths with hot and cold water. We could get a daily bath. It was necessary to pay the caretaker. We had hand bowls and a pump in the yard for washing our hands. One towel was supplied to each prisoner.

Exercise.—At first we only had a small yard about one hundred by sixty yards, but later the outer court was opened, where we had ample room and could play football, rounders, and tennis. The tour of our domain was nearly a kilometre.

Work.—Medical work, *nil.* At first we had to do all the work of the place, i.e., clean our rooms, clean the courtyard and the drains, wash up crockery, draw rations, wash clothes, carry coal, and peel potatoes. On September 17 some orderlies arrived, one for about sixteen officers. This relieved us of the most unpleasant

fatigues, such as washing up and the care of drains. We still had to help a good deal, and the early morning potato peeling roster persisted almost to the end. Peeling potatoes at 7 a.m. in the open on a cold November morning is not a desirable occupation.

Discipline was not strict—we had one roll-call a day at 10 a.m., except for a short period when we had two as a punishment for some offence.

Several petitions for release were sent in by the medical officers, of whom there were thirty British. All were unsuccessful. We were not allowed to see any newspapers with the exception of the official *Extrablatts* posted in the camp. Later we were allowed to buy the local paper. No letters were allowed to be sent off till October 6. The writer got no news from home till October 19, when a telegram arrived. It was sent off on September 2.

The following letter to the Senior British Officer from the German Commandant is worth recording:—

"Every day applications from British officers reach me which are so entirely without justification that it is not worth my while to take any notice of them. Officers appear still not to realize the fact that as prisoners of war they have not so much rights as duties. They are not to take up my time with the expression of foolish wishes. If this state of things, which betrays a certain bumptiousness on the part of British officers, does not cease immediately, I shall take the opportunity to put into each room a French sub-lieutenant risen from the ranks, and I shall further apply that a proportion of your Allies, the Russian officers, may share your rooms. This order of mine is to be posted up in the British quarters. Will you please, Colonel, report to me in German the fact that these instructions have been complied with.

"(Signed) BRAUN, *Captain.*

"Officer Commanding, Prisoners' Depot."

Here is a reply to one of our petitions for release:—

"Torgau, September 18, 1914.

"Colonel Gordon,—The doctors and chaplain are not, as was communicated to you in the beginning, looked upon as prisoners of war, and are not being treated as such. They have rather fallen into our hands and are to follow their avocation under our direction. We are only at the beginning of the enormous World War and shall still have many thousands of English wounded to care for, for which purpose the accumulation of English doctors will be detailed. The same is the case with the chaplain, who can, and does, already carry out his duty. Only when the personnel of the

Red Cross is no longer required—that can only be towards the end of the War—can there be any talk of return to England. If the gentlemen imagine that they cannot move freely in the town is a breach of the Convention, so must it be mentioned that the Convention expressly demands that doctors should be protected. Their detention is protective, as our populace is particularly bitter against the English as the promoters of this War. It would be almost impossible for the authorities to protect them in the interior of the town. At any rate, the above-mentioned officers obtain the same rate of pay as officers of the same rank in the German Army.

"(Signed) E. BRANDE."

With reference to the above letter it is worth noting that medical officers at this time received 100 marks a month. The writer received pay at the rate of 100 marks a month for five months, and at 595 marks a month for the second five months.

As regards employment, the writer was not employed in any way till February 11, 1915. From February 11 he was nominally employed in the care of some seventy British prisoners, whose wounds were practically healed, in a camp where there were two German, two Russian, and twelve French doctors.

On September 22 a notice was posted asking British officers to subscribe to the German Red Cross. Many officers subscribed by cheque. The receipt of these cheques by the London banks was the first intimation received in England that these officers were alive. The writer's wife was notified on October 7, having been without news of any kind since the middle of August.

An extract from a German paper, the *Leipsiger*, No. 247, published from September 3 to 10, is worth reproduction:—

"*Unworthy Behaviour towards Prisoners of War.*—In the first few days several hundreds of persons have thronged to the prisoners of war in the most persistent manner and have helped them with "presents of love" (Lebensgeben), especially tobacco, money, and flowers. Further, professional and amateur photographers have appeared in such numbers that it almost seems as if it was the most important task of the German photographer to obtain pictures of French prisoners. It is pitiable and incomprehensible that the earnest recommendations that have hitherto been issued have not sufficed to put an end to behaviour which amounts to hysteria.

"The Commanding Officer of the Bavarian Army Corps is compelled to forbid photography. Further care has been taken that the names of those people who, devoid of any patriotic feeling and

devoid of tact, have provided the prisoners with gifts should be at once taken and published in prominent places in the daily papers."

Life at Torgau was monotonous. One learnt French and taught English, but one got sufficient exercise. The writer spent five months there grousing at his lot, and a second five months elsewhere wishing he were back again.

One British officer called a German workman "a Schwein" because he dropped a hammer on him. The officer later got five months' imprisonment for this offence.

On November 25 and 26 all British officers were transferred to Burg. The procession from the camp to the station was unforgetable. Very limited transport was allowed, so each officer carried nearly all his worldly possessions. These were packed in anything between a Wolsey valise and a jam bucket. It was snowing hard too. We had a great send-off from our French Allies and many of us left behind very good friends. The writer was fortunate in only remaining at Burg some ten days.

General Conditions at Burg.—All knives and razors which we had bought at Torgau were taken from us. All ranks were mixed up, colonels receiving the same treatment as subalterns. Equal numbers of Russians and English were placed in each room, and no two English officers were permitted to sleep side by side.

Housing.—We were lodged in converted gunsheds and stores. Some rooms were fairly good, others were very bad. The lower rooms were quite unfit for occupation. Here are particulars of one room. It had accommodation for about forty officers. Windows on one side only. The window space was about a quarter of that allowed for a common lodging-house in England. These windows were hermetically sealed by large iron doors for twelve hours out of the twenty-four, i.e., from about 6 p.m. to 6 a.m. Ablutions were performed in the passage or in the room. All meals were taken in the room. The bedding was better than at Torgau, officers' sheets and iron bedsteads with a sort of spring mattress were provided.

Discipline was strict and oppressive. There were some thirty-nine rules. Roll-call took place at uncertain hours, sometimes once, sometimes three times a day. Beds had to be made in a fixed way. It was forbidden to sit or lie on the beds during the day. Walking in the courtyard after dark was forbidden, but we could go to the latrine one at a time up to 9 o'clock. A German non-commissioned officer was in charge of each room to enforce discipline. One officer who possessed a deck-chair was permitted to sit on it, but not to lounge in it fully extended. All the German

officers were very hostile to the British, but were much less so to the Russians and the few French who were there. All windows had to be shut at night.

Latrines.—Deep trenches, very dirty and quite insufficient. Only eight seats were provided for about four hundred officers, situated fifteen yards from one canteen and about forty yards from the other. Urinal usually overflowing and the urine permeating into the soil.

Ablution.—One small bathroom with two baths, quite insufficient. One bath a week only allowed. In addition we had basins in our rooms.

Messing.—Three official meals a day were provided by the administration. The price of this was stopped from our pay. The food was generally eatable but the quantity was insufficient. There were two good and clean canteens where at first one could buy excellent food. By degrees nearly everything was forbidden.

Exercise.—The courtyard available was about two hundred yards long by thirty yards wide, for about five hundred officers and men. Further, we were not allowed to cross it at the lower end, so had to walk up and down instead of making a round.

Work.—Medical work, *nil.* We had sufficient orderlies to do our other work. Washing was sent out to a laundry.

Irish Roman Catholics were separated from the rest with a view to preferential treatment. When it was realized that they were not inclined to espouse the German cause the matter was dropped. Some thirty-seven of us left Burg for Halle on December 6. The writer, for one, had no regrets.

General Conditions at Halle.—Halle is a large, dirty manufacturing town. The lager was an old factory converted. Dirt was the prevailing feature.

Housing.—British, French, Belgian and Russian officers were all lodged together in large dormitories. Numbers varied; in the writer's room there were thirty-four. In some rooms the beds were two-deckers, and all were of the same type as at Torgau. No cupboards of any kind were provided and some of us had no shelves or even hooks. The rooms were very dirty and ill-ventilated, with windows on one side only. The number of orderlies provided was quite insufficient to keep the place approximately clean. The bedding was the same as at Torgau, and linen was supposed to be changed monthly. The writer had the same linen for nearly two months. Lice were fairly plentiful.

Latrine.—Deep trench, very dirty, insufficient, and only cleaned out as a last resource.

Exercise.—The factory yard, dirty and rough; the round was some three hundred yards.

Work.—Medical work, *nil.* We had to clean our own boots and help with the messing arrangements, as the number of orderlies was insufficient, and further, they were constantly taken away by the Germans for fatigues. Washing was sent out to a laundry which was good and cheap.

Messing.—We messed in an enormous old workshop which was filthy. We formed messes of about ten. The food was cheap and very bad. Certain extras such as sausage, ham, jam and margarine were procurable at the canteen. All luxuries were strictly forbidden.

Ablution.—A good and fairly clean bathroom with shower-baths, also a lavatory not too clean. One could have a daily bath.

Discipline.—Not so strict as at Burg, two roll-calls a day. The German officers were quite agreeable and polite.

Life at Halle when one got used to the dirt became bearable. Several incidents are worthy of being recorded.

During December and part of January all foodstuffs were taken from our parcels "for the Red Cross." We were unable to obtain a receipt from the Red Cross. It was heartrending to see plum puddings and cakes go away like that.

The sale of tobacco at the canteen was forbidden and on the last day we all laid in large supplies. Two days later, on January 4, all smoking was forbidden, and on January 5 all the tobacco we had bought was taken from us, that is to say, all that was found.

Twice, on December 19 and January 26, we were stripped to the skin by civilian detectives in the presence of private soldiers without the presence of an officer. Dogs also assisted. We thought they were searching for gold, they did not find much. They took a few other items such as field-glasses. We were searched on another occasion by the military authorities for maps and note-books. Some of the latter were probably interesting as critiques on German methods. We were all disinfected and our clothes were baked. This procedure ruined many uniforms, particularly breeches, and was quite useless from a practical point of view. Many articles of clothing were lost altogether. Several officers were sent to prison for disobeying the smoking edict. One medical officer who had undergone two months' solitary confinement was in this lager. The writer was on February 11 transferred to Quedlinburg, a man's camp, where he was nominally in medical charge of the English prisoners.

Condition of Medical Officers at Quedlinburg.—We, that is

twelve French, two Russians, and the writer, were housed in small wooden huts. For some time there were eight of us in a hut, seven metres by five. We each had a chair and there were two small tables. No cupboards or shelves were provided. No baths were available, so we had to tub in the room. We had one fairly good meal a day at the kitchen, for which we paid 1 mark 50 pf. We made and cooked our own breakfast and supper, from the contents of parcels and from such food as we could buy locally. Later we were given a third hut, so that we only had five in a hut. That was a great improvement. The duties were very light, as most of the wounds were healed, and with the exception of tubercle, which was prevalent in every form, the health of prisoners was good. The writer's official capacity was Reserve Medical Officer for "Feld III." Practically he looked after the English, whose numbers varied between sixty-one and eighty-one. For exercise we had the "Feld" yards, which were about two hundred yards long. We could move freely from one "Feld" to another, but were forbidden to enter the men's hutments. When the new "infirmary"—really a medical inspection room—was completed, good baths were available.

There were about ten thousand prisoners, Russian, French and English. They were all inoculated by us against cholera and typhoid.

Smoking was for a time forbidden, but later was allowed with certain restrictions as to time and place. For medical officers latterly there was practically no restriction. We were not allowed to leave the camp except to proceed to the camp hospital, when we were accompanied by an armed guard.

Conditions of the Prisoners at Quedlinburg.—The camp is administered by a general. The prisoners are divided into two battalions of four companies each. Each battalion is commanded by a major, and each company by a captain or subaltern. Each company is a separate unit with a permanent staff of German N.C.O.'s.

The companies are divided by barbed wire fences. One kitchen cooks for two companies. The main latrines are well away from the kitchens. They are deep trenches, cleaned out by hand into carrying barrows which are by no means watertight. Considerable soiling of the camp occurs in the process of cleaning. There are smaller latrines in close proximity to the kitchens. Some latrines are now emptied by a kind of pump.

Housing.—The men are housed in long wooden huts which are not rainproof. There are two types of room. One is 75 feet by

35 feet and holds about 150 men. The air space in the other type is similar. Mattresses stuffed with shavings are allowed in the proportion of four mattresses for six men. Two blankets per man are issued. The rooms are heated by stoves and have sufficient windows.

Food is meagre and very unappetizing, in fact at times uneatable. The writer believes that counting it in calories it is sufficient to support life. The warning with reference to overloading of the stomach mentioned in paragraph 7 of the German official instructions is faithfully carried out. The potato bread is very nasty, it is rather like india-rubber; all the same, a larger ration would be very acceptable to the prisoners.

Breakfast consists of black coffee. The coffee is said to be made from acorns.

Dinner.—A vegetable stew flavoured with meat or fish. It would often be better to leave out the meat or fish.

Supper consists of a "soup" made of starch in some form and water. Rice, flour and beans are usually employed. Two hundred and fifty grammes of potato bread is issued daily. Fresh milk was not available at Quedlinburg. Tinned milk, sardines, potatoes and inferior kinds of sausage can be bought in the canteens. Without parcels from home the men would almost starve. The Russians suffer badly in this way and their health is not nearly so good as that of the British and French. The feeding has improved somewhat since the administration have taken over the messing in place of contractors.

Work.—The fatigues are not now heavy. While the camp was in the making and the weather bad the work was hard. Men who are ill or incapacitated by wounds can obtain exemption tickets from the medical officer in charge.

Medical arrangements are satisfactory. There are ample dressings, drugs are occasionally short. The new hospital is good. The old one left much to be desired. An isolation hospital is ready in case of an epidemic.

Health.—General health fairly good. Tuberculosis in every form is rife, also pneumonia and bronchitis are common. All this is due to the overcrowding in the huts and deficient food. Much of the overcrowding might be prevented by local organization, as there are often empty huts available. Out of one hundred and one deaths in the hospital up to May 10, 1915, forty were due to tubercle, and there have been others since then. No isolation of tubercle patients is carried out. There are many men of all nationalities quite incapable of serving who should be exchanged.

Clothing.—Practically no clothing is provided by the German administration and it is very difficult even to obtain clothing sent out from England for the British prisoners. Clogs made of solid wood or of wood and leather are issued from time to time to men who have no footwear whatever. Smoking is allowed in the open at certain hours. Tobacco is now sold in the canteens. Parcels arrive fairly well. Few are lost. They usually take about a month to arrive. Letters are variable and many are lost. On one occasion I know a simple method of censoring was employed, a sackful being burnt.

Discipline is fairly strict and is enforced sometimes in an unpleasant manner.

One may gather from these remarks that the lot of a prisoner of war is not a pleasant one, but it is much better now than during the early months of the war.

The British owe a great debt of gratitude to the American Ambassador at Berlin who, in the face of much obstruction and subterfuge, has done so much to relieve the sufferings of our prisoners. Much yet remains to be done, and it must always be remembered that an inspection of a camp is a set piece, much forethought being expended by the authorities as to the staging.

The writer himself owes much to his French and Russian colleagues at Quedlinburg and to the many good friends in the French rank and file. Arriving at Quedlinburg alone, the only British officer, he was welcomed like a brother and everything possible was done to make his lot as comfortable and happy as possible. He left Quedlinburg feeling quite certain that the interests of the British prisoners would be thoroughly well looked after by their French Allies. A French adjutant was left officially in charge of British interests and he has done much good work already and is willing to do any amount more.

SOME MUSINGS OF AN IDLE MAN.

By Colonel R. H. FIRTH.

I.

A short time ago, I was on a steam trawler and had opportunities of observing the huge catches as they were emptied from the nets on to the deck. As one stood and contemplated the myriads of these denizens of the sea, one could not help wondering at the abundance, its continuance from day to day, year in year out, and as to what happens in the vast economy of the ocean. There were tons and even miles of fishes, to say nothing of the countless numbers of great and small crustaceans, copepods, diatoms, and the multitudes of infusoria. The fishes alone represented a recent locomotor power in the sea which the mind could not grasp, and yet a power soon to be transformed into a corresponding enormous power of both muscle and brain work on land. Even the offal or rejected sweepings would go to feed cattle and to fertilize the ground. One was almost aghast at the magnitude of the problems presented, and one's thoughts took the following direction.

The producers of the wealth of the ocean are the chlorophyll endowed organisms, most of which are undoubtedly plants. Of these plants, there are two great groups in the sea : first, the phytoplankton or minute algæ of the superficial layers of the ocean and, second, the larger seaweeds or sea-grass, and the attendant microflora abounding in the shoal waters or shore areas. Possessed of varied pigments, all these have chlorophyll and, by virtue of that complex of glucosides, are able to utilize the energy of sunlight to build up the simple constituents of air and sea-water into more complex organic products, which, in turn, form the food of animals. On this power of photo-synthesis depends clearly the whole economy of marine and terrestrial life. Our thoughts then picture the minute and simple algæ of the open seas as so many floating meadows, and on these pastures feed many inhabitants of the open seas, such as small crustaceans, which again are devoured by young fishes. In this sequence of events we conceive the growth of the sea-meadows in spring to be as important as the garment of green on a farmer's field. Close thinking further explains the observed correlation between the sunshine records of May and the quantity of mackerel in the fish markets. The rationale of this is instructive and simple, because there is a correspondence between

the catches of mackerel during May and the amount of small crustaceans of drifting habit, or plankton, upon which the mackerel feed. These small drifting crustaceans or copepods, in turn, feed largely on the drifting algæ and plant organisms of the surface waters, such as diatoms and peridinians. But the multiplication of these minute organisms depends in the main on the amount of sunshine, so that we come to the sequence of the more sunshine the more mackerel. The incarnations follow one another, copepod after diatom, mackerel after copepod, and man after mackerel; truly, a marvellous illustration of the circulation of matter, and a suggestion that as, on land, all flesh is grass, so, in the sea, all fish is seaweed. Important as the minute constituents of the phyto-plankton are in life, they seem equally important in their death. For when they are killed by changes of temperature or when they reach the end of their natural growth, they add to the valuable organic detritus which remains in suspension in the water or sinks to the floor of the sea. Thus, we come to the conclusion that the producers in the economy of the sea are the chlorophyll endowed plants and such small animal organisms as have stolen their secret of photo-synthesis.

If such be the producers, who then are the natural consumers of the wealth of the oceans? First, there are true carnivores, like most fishes, all the cuttle-fishes, the whelks, and many gasteropods, most of the starfishes, many of the crabs, and so on down to the sea-anemones. To these we might add certain vegetarians, like limpets and periwinkles, on the shores, and some of the open-sea animals like the copepod crustaceans; while a third group of consumers is the enormous multitude dependent on detritus. Though one thinks thus of the consumers, one does not put the classification rigidly, for it is probable that the distinction between carnivore and vegetarian is not so important as that between organisms with and organisms without hard prehensile and chewing mouth-parts.

Between the consumer and the producer there probably is a middleman. The marine middlemen are surely the bacteria. True, salt is antithetic to them as a class, but it has not kept them out of the sea, where they have more than one rôle to play. Thus some are putrefactive, reducing the dead bodies of animals and plants to carbon dioxide, ammonia and the like, which may re-enter the field of life by forming food for algæ. Bacteria of this kind are the scavengers, making clean things out of the unclean; but there are others which play a subtler part, by changing the ammoniacal

nitrogen into nitrites, and others which continue the work by completing the oxidation into nitrates. Besides these, however, there are many denitrifying bacteria, which work the wrong way by reducing nitrates to nitrites, nitrites to ammonia, and ammonia to free nitrogen. Associated with this question of denitrification is the curious fact that the cold Polar waters are richer in plankton than the tropical seas; the reason of this is not quite obvious, but it may be because the higher temperature favours the action of denitrifying bacteria which, by flourishing abundantly, lessen the supply of available nitrogenous food for the phyto-plankton. An alternative view is that low temperatures slow the vital processes and increase the length of life, so that several generations of plankton organisms are living contemporaneously in the colder waters; possibly, both views are correct.

One has imaged producers, consumers, and middlemen in the economy of the ocean, but we must not push the analogy too far; thus, bivalves and their kind that feed on minute detritus or debris are ever making available, to creatures that eat them, supplies of energy which would otherwise be wasted. We know that plaice in some waters are very fond of lancelets which subsist on detritus particles, hence it follows that, in respect to the plaice, the lancelet is a producer or even a middleman. In whatever way we think of the facts, we see a never-ending cycle and true circulation of matter. The algæ find nourishment in the water that bathes them and, using chlorophyll to conjure the sunbeams, build up organic compounds from inorganic constituents. Eaten by animals, the vegetable proteins are raised to a still higher grade as animal proteins; but when the plant or animal dies the complex organic substances are broken down through the agency of bacteria into simpler forms once more, and some of these being utilized by plants may enter again into the circle of life. Next time the reader eats the cod, let him remember that the cod fed probably on a whiting and the whiting on the sprat, and that the sprat feeds on copepods, which again depend on peridinians and diatoms. Such are the incarnations of the sea, and so the world goes round.

II.

While at a Church service the other day, and while the creed was being recited, the thought was irrepressible how interesting it would be if, instead of repeating the formal words of the Church service, each person were to proclaim aloud the creed of his own mind and soul. One thought all this and one writes it now, in no spirit

of doubt or scorn of the beautiful words so familiar to us, but impelled by thoughts which suggested a spiritual exercise that many of us might well make an effort to do inwardly, and perhaps obtain some advantage. One realized how many might draw therefrom some measure of consolation, for the simple reason that the creed of the soul is not always the creed of the intellect; it is usually simpler and more satisfactory. If we analyse ourselves honestly, we cannot deny that we all inwardly repeat beliefs involuntarily and constantly. Even the least introspective among us hear a creed or belief resounding in our souls, often with surprise, sometimes with delight, occasionally with dismay. The situation seems to be, that the ceremonial of the soul permits of no interruption. If we think of our fellow-intimates we know and realize that, now and then conveyed by talk, by looks, by actions, or more often perhaps by that indescribable emanation of the character perceived both by long and sudden sympathy, we get to know the latent beliefs of other men. I may be expressing myself badly, but what one aims to bring into prominence is that in most of us there is a latent belief, which one calls the belief of the soul, not always consistent with the belief of our mind or intellect. Our intellect is peculiarly liable to the influence of pessimism, and very few of us can maintain a state of optimism by reliance upon the mind alone. By all experience, life is a tragedy, yet as our minds argue this out, within most of us there echoes an obverse platitude which whispers "It is all for the best." Our intellect is usually impatient of this inward belief, but by it our spirit or soul lives, and when we hear simple people or those whom we think simple people saying this, we ought to remember that they say it because they cannot help repeating aloud their latent creed, the creed of their soul.

This line of thought brings us to the problem of fatalism, which is one of the commonest beliefs of our minds. To some, this may seem a surprising statement, because they are imbued with the idea that fatalism belongs only to the East or to paganism. It is repellant to the religious-minded as, if pushed to its logical conclusion, fatalism denies the power of prayer, but it is reconcilable with reliance upon Divine protection. Fatalism has been closely allied with some forms of Christianity and, as an inner belief, dies hard; if any doubt it, let them think of the many who find the fears, which reflection and introspection raise, to be allayed by the instinctive assurance that "what will be, will be," and how the still small voice from within whispering the words "che sarà sarà" gives to us all a negative courage and perhaps a negative peace.

Conversely, one imagines many a Moslem brought up to use the Arabic equivalent of those words as part of his intellectual and religious faith, hearing other words prompted by his soul and, as he bows his head in the mosque, says in his heart that man really is master of his fate; if so, then his soul voices a theory which accords far better with the faith of the despised infidel than with his own. Of course, there are many men into whose souls the fatalistic belief does not enter, and there are others who, if they do uphold fatalism intellectually, mistrust it inwardly. These latter are not prepared to admit it, yet they do feel instinctively that the natural course of events can be interfered with or at least modified by personal effort.

As illustrating, further, the argument of this theme, one thinks of the very many who find it difficult to uphold by reasoned argument the efficacy of prayer for any but spiritual benefits. These people represent, typically, the diametric opposition between the belief of the mind or intellect and of the soul, because in every crisis of fear or perplexity they pray for benefits which are not spiritual. Again, one thinks of the many who have grave intellectual doubts as to the life after death, and yet one goes so far as to say that there are few of them who have not been frequently startled to hear the sounds of a creed which affirms it, being repeated in their souls. In these times of mourning the greater number feel for a few moments or hours the dear companionship of their dead; and, after all, what is it that they hear? as it were from within. Surely, if they put it into words, sounds very like "the life of the world to come"? The echo dies, and they realize how hard the old belief dies; also they know that this is not the last time that those words of the latent belief of their souls will be repeated as a small voice from within, and in spite of the oft-spoken words of their intellectual belief.

The net outcome of these reflections brings one to the conclusion that, in spite of the vaunted scepticism and fashionable materialism of the day, the majority of people are, at heart, more Christian than they think they are, and that that faith appeals far more to them on its spiritual and supernatural than on its moral side. To many who believe in their inmost consciousness or soul, however much they doubt in their minds, that a world of the spirit does exist where men do not see death, the Christian or biblical morality is repugnant. All this seems curiously painful and inexplicable, and yet one cannot avoid the conviction that some apparently groundless and inexplicable beliefs form at least sub-

sidiary clauses in the creed of most men's souls. We laugh at those pet beliefs, but in our inmost hearts we believe in them, and cannot escape from their constant repetition within the inner sanctuary of our thoughts. We cannot explain them, but we have to admit that they hold a place with that which is most vital. At this point we may be content to leave the subject, perhaps astonished to find that a thought, which originally promised to expose the baser side of our fellows, develops towards a realization that man, in spite of his intellectuality, is dominated largely by beliefs which are independent of his mind.

III.

In the preceding note one has laid stress on the word "within." It is worth while thinking out what pertains to the studied use of the word, as it involves a right understanding of the relations between externality and will. The influence of materialism makes many think of "within" as referring to that portion of space marked out by our bodies, and "without" as referring to the rest of space. If we think a little, we realize that this is an error. By the "within" is meant the region where our will is supreme, flowing only into thought and not into action, that is where the will meets with no opposition; this is tantamount to saying that "within" is the realm of imagination. On the other hand, the "without" means that region where the will, passing into action, meets with appreciated opposition, and is synonymous with the realm of Nature. Were it possible to remove the inertia of bodies, we can assume that the distinction between the "within" and the "without" would disappear; hence this distinction is not one of space. Moreover, we can discover pure will nowhere in man's body; we observe only many of its effects, just as we do in the world that lies outside of his body. Evidently, therefore, the spirit or "within" is not in space, since space, being an idea, can exist only in mind or spirit; and if space exists in spirit, spirit cannot exist in space. We are forced then to think that the external world is the product of a will not our own, and that fact constitutes its externality, and not any supposed spatial relations between it and ourselves.

We advance next to the realization that the reality of the ideas of our imagination is purely individual or subjective; thus, for the man who imagines money, that imaginary money is quite as good as so-called real money, but it will not satisfy his creditors because

their imaginations are not forming a like product. On the other hand, our sense-impressions are in the main objective. But, since all experience and knowledge exists only in mind, it is evidently subjective, and absolute objectivity is unthinkable. This difficulty, however, is overcome if we postulate a Divine or Supreme Mind, and we realize that what we call objective is really subjective, that is to say, existing in or subjective to the Supreme Mind. Of course, in thus thinking of the physical universe as an idea in the mind of the Supreme, one understands it as an idea which is willed forth, and Nature is nothing more than the externality of the Divine or Supreme. It is because of our likeness to the Supreme, that this real physical universe is possible to some extent to us as an ideal construction corresponding to the Divine ideal construction. The external world we know is the world as it exists in each of our minds, but the real external world is the world as it exists in the Supreme Mind, and in so far as our ideal constructions are like or approximate to the Supreme or Divine, do we know Reality. It follows, therefore, that all science and all efforts to interpret sense-impressions, by elimination of the errors of the individual, is an attempt to read rightly the thoughts of the Supreme Being. A difficulty suggests itself here: it is that however desirous one may be of believing in a God, may not this belief be regarded as an act of faith rather than as a product of reason? Reflection compels one, however, to say that the whole logic of experience absolutely forces us into the belief, and that we have more sure grounds for the belief in the existence of that infinite Will and Mind, which we call God, than we have for that of finite minds other than our own. Each of us in our daily life perceives motions, changes and constructions of ideas, which inform us there are certain particular agents like ourselves which are associated and concur with their production. Hence the knowledge we have of other minds or spirits is not immediate, as is the knowledge of our own ideas, but depending on the intervention of ideas, referred by us to agents, or minds or spirits distinct from ourselves. Now, though there are many things which convince us that human agents are concerned in producing them, yet it is evident to all of us that those things which we call the works of Nature are not produced by or dependent on the wills of men. We are compelled therefore to think that there is, though we cannot prove it, some other agent or spirit that causes them, and, from this line of thought, we get driven to the conclusion that this universal or master Mind, which we call God, is known as certainly and

immediately as any other mind or spirit which is distinct from ourselves.

But, it may be argued, some philosophers, notably Hume, have professed to disprove the existence of soul and spirit or mind, and reduced the individual to a mere series of separate sensations or phenomena. True, this claim has been made, but our sensations are governed by definite rules of order and sequence, called the laws of Nature, and also connected by the fact of memory. Just as the laws of Nature indicate the existence of God, so does memory indicate the existence of the individual spirit; and for this to be true it is not at all necessary that memory should be capable of recalling the whole past history of the individual, but merely that it should link together every moment of its consciousness with the immediately preceding one, so as to make it possible to trace out the above-mentioned sequence; and this memory always does. Further, the sense-impressions which I call "mine" are related to one another quite differently from the manner in which they are related to those called "yours"; this is because they are mine, and find their unity in one mind or spirit which is myself. Also, the fact that I have any idea at all is to me proof of my own existence as a mind or spirit and confirms Descartes' saying that, "I think, therefore I am." At this stage, further reflection raises the question, but if the individual spirit or mind can have an immediate knowledge of his own existence, not derived through ideas of sense, may it not be possible for him to have a like knowledge of other spirits or minds? One feels convinced that it can be possible, and the group of phenomena classed as telepathy are an example in point. In them we have the undoubted transmission of ideas from mind to mind, without the utilization of the known organs of sense. It is true that what are conveyed are ideas, but such ideas appear to be transmitted by a more interior way than that of physical sense; hence they are not ideas of sensation, though objectively true. It is difficult to withhold the opinion that they are the result of a direct perception by one mind of the ideas of another. Moreover, we may have notions of the relations between ideas. There are ideas which are, as it were, exterior and physical; there are others which are more interior or more spiritual. A man who is aware of his sensations may be said to know something of what one calls the externality of God; but how far more deeply into the knowledge of the Supreme Being has the man of science penetrated by knowing and appreciating the laws of Nature? Having once admitted the possibility of a scale of

discrete ideas, one feels amazed to think, or ask the question, who shall state where the process is to end?

Another thought obtrudes itself here; it is, that we cannot restrict the universe to the concept of it in mind. The possibilities of sense impressions far transcend the experiences of any individual. The first concept we form of reality is that derived from our sense-impressions, and the world around us is regarded as a real and permanent existence independent of mind. If we argue it out, our reason tells us that what we term the properties of matter are known to us only as sensations or percepts of our minds, and that we know really nothing of matter in itself; that is, nothing beyond the properties which we experience as sensations. Suppose we were deprived of some of these gateways of knowledge, say sight or touch; or, if other and more subtle senses were given us, how different would be our concept of the external world? Therefore, all we can assert is that external phenomena arouse a succession of mental states, and our present interpretation of those states may be only a little less fallacious than the erroneous interpretations we should give if we possessed but a single sensory organ. Clearly, our ideas of the world without us contract or expand in proportion to the extent of the means by which that world is perceived. Perception being impossible without a mind to perceive, mind is certainly the deeper reality, and Nature probably a mere construction or projection from our minds. From this point of view, Nature and ourselves are the appearance or vesture of the Supreme Mind, and the real world is the world of the Supreme Thought. Perhaps at this point one may be pardoned for expressing the reflection that Nature does not exist only in the thought of men, nor for the thought of any one man, nor by the united thoughts of all men, but it exists as the symbolical expression of the Supreme Thought, and is sustained perpetually by the Supreme Will. Against this view is the difficulty of explaining the independent existence and activity of the conscious self, for the self is not an idea nor an object of internal observation. One can explain it only by thinking the ego to be conscious of its activity only when that activity is opposed, or when effort is needed. We know that an effortless action arouses no consciousness, therefore effort lies at the root of consciousness, and behind the sense of effort in the ego lies impulse or desire. If so, then effort implies desire and opposition to that desire.

Whatever view we take, we seem compelled to admit that all our experience of phenomena is due to some form of action from

without upon our minds. The materialist says this action is due to things in themselves, and that the stream of consciousness within us accompanies the brain processes, much as a shadow accompanies an object in the sun; to such a man, Nature is as the curious, orderly marks on this printed page, the order, regularity and continuity of the printing being due to the interaction of the black marks among themselves, a chance collocation of atoms endowed with properties which have to be explained. Admittedly, one does not accept this, but rather thinks this ultimate reality to be mind, a Supreme Mind, of which our human minds give us a faint adumbration. Suppose we take the example of a printed page; we can read and understand the human thoughts expressed on that page, because we have something in common with the writer of the page, and that something is mind. The printed words do not enable us to see the author, nor do they in any way resemble him; but the printed signs are intelligible because our intelligence is related to his intelligence. And so the mental signs which the phenomena of Nature present to us are not the real world, for that, being the world of the Supreme Mind, is inaccessible to us. But those signs reveal order and purpose, and we can more or less imperfectly interpret those signs because they are an expression of an intelligence which is related to our intelligence, and can communicate with our minds. We see ourselves, therefore, as parts of a larger whole and we realize that that which is within each of us is the recognition, the development and the manifestation of the greater life within.

IV.

A newspaper paragraph arrested one's attention the other day It was to the effect that someone, I think Marconi, had perfected an instrument or means whereby people could see through some two or three feet of brick wall. In these days it would be rash to say or even think such an attainment is impossible, but the whimsicalities associated with the very suggestion of it were irresistible. The first thought was, shall we welcome any ability to look through solid walls? To most of us it will be of doubtful and embarrassing applicability, especially as it might be used for unworthy purposes, and, in the hands of degraded persons, be employed in a manner that we should condemn. If we are to be able to see through brick walls, it will be within practical politics to look round corners, and then surely our later state will be indeed worse than our first. Of

course, looking right through a wall is a more straightforward procedure than looking round a corner, but both suggest prying and spying. We doctors are all familiar with X-rays, and know how it is possible to see through a man's skin and flesh and look at the actual condition of his bones. Odd as it may seem, but I well recall a case when a man flatly refused to submit to the X-ray process on the plea that his bones and insides were private and not to be looked at by doctors or anyone else. True that was in the early days of that discovery, but it might find many echoes nowadays if we could walk about the streets using the X-rays and looking right into people.

Suppose we ever do come to be able to see through walls, let us hope that it will be incapable of being used in any free and easy manner, for if not, away goes all privacy. Many readers of this Journal are married, let such a reader think of himself at his club or perhaps dining *à deux* at a restaurant, when he wished it to be supposed that he was attending a meeting of some learned society. What would become of that sense of security which he has hitherto enjoyed if he knows that anyone, who wants to discover him, can look through the wall and see him *flagrante delicto!* One might give other examples which suggest not only domestic but other storms; the very thought raises many shudders.

The present-day efficiency of the telescope and field glass is notorious, and, though perhaps not going so far as to warrant a claim to read a letter at long range, still with a potential invention by which you can look through a two-foot thick brick wall in prospect the outlook is disturbing. We shall all have to write with invisible ink, and even that precaution would not provide a complete safeguard. To begin with, the use of invisible ink very properly arouses the suspicion of the authorities; but, apart from that, a message written in invisible ink cannot serve any purpose until the writing is made visible, and then, of course, the hypothetical danger is as great as ever. Undoubtedly there is much writing that would be better left invisible for all time, while some may urge that it would be better not to write at all, than to write that which can never be seen; but, as readers of this Journal know, some men have a mania for writing, apparently for the mere joy of the thing. Without being too pessimistic, one is unable to repress a fear that, if this reading through brick walls apparatus matures, some other restless inventor will scheme out an appliance by which men will be able to read each other's secret thoughts; truly, when that day comes, life will be made intolerable, tempered

only by the circumstance that everyone will, in self-defence, have to be sincere. Many of us have read the story of Judith Lee and her powers of lip-reading. If the world contains many more like her it will indeed be a case of not knowing where we are, because there will be little secrecy and certainly no privacy.

V.

On a recent railway journey, my only fellow-traveller for many miles was a citizen of the Great Republic. He was an interesting and much informed man, but one whose mentality was warped by the importance of wealth. In that respect he stood not alone in this world, but, after he had left the carriage, one could not help thinking over the mystery of wealth and the varied aspects suggested by the love of money. One recalled the cynical remark of Dr. Johnson, wherein he said that men are never more innocently employed than when they are making money. But he might, with equal truth, have added that they are never more naturally employed. To make money, or at least try to, and leave it to their children, is as natural to men as to make love and beget children; and it is safe to say that no force can prevent it.

In the eyes of some people the love of money is the root of all evil; certainly it is the root of some evil, but it can hardly be the root of all evil, for it is only one perverse passion out of many. There is, however, a kind of respectability about money which makes the love of it peculiarly insidious and dangerous, since it conceals from the lover the nature and effects of his passion. If a man wants too much food we call him greedy; if a woman wants too many clothes she is evidently vain; but money is not a thing like food or clothes, that can be enjoyed by itself; it is only a means of getting the things that can be enjoyed, consequently desire for money is really an indirect greed. We may regard it as a civilized means of conducting the struggle for existence, which to a great extent conceals from those who use money the ugliness of that struggle. Another way of regarding it is to call it a kind of diplomacy, politely conducted, behind which there is war; but the diplomats do not see the war. They deal only in documents, and they are not aware, except at second hand, what all those pieces of paper and the struggle about them mean to the mass of men. Most of us know one or more very rich men who are greedy for wealth, but it is doubtful whether those men are really greedy for all the things that money will buy. Although money keeps its

actual power and is prized for that, most of those wealthy men, in their own minds, divorce it from its real meaning. To them money is, or becomes, a mere symbol of something more romantic than it is; it inflames their imagination and the imagination of a great part of the poorer world too, as being or contributing a personal quality in the man who possesses it, and not merely a means of buying material things.

We all know that wealth can be used for great and noble purposes, but the man who is greedy for money does not usually want to use it for such purposes. More often than not, he does not want to buy an excessive number of material things; his greed has become abstract and is a desire for a symbol, quite forgetting what the symbol means. Further, this curious greed for a symbol spreads among people who are not otherwise greedy. The respectability of money wraps itself round them and conceals from them the character and results of their inordinate desire. They see only lists of securities, not heaps of gold; and even if they do quarrel about money with someone else, perhaps equally greedy for it, there is no open scrambling, but only a very decorously conducted lawsuit. All the winner knows is that he has got judgment in his favour, which means that he acquires a certain number of material things from his opponent. But it does not mean all that to him, but rather a kind of justification conveying to him a moral and legal right to own the money he gets through it.

These things are plainer to us in this time of war, because we now see greed for money as it really is, and we no longer reverence a rich man simply on account of his wealth and what he might do with it; we have other tests forced upon us. We judge a man for what he does, not for what he might do; that is, we value his personal qualities rather than his possessions. All our experiences tell us that a man may be poor, not because he is a weakling, but because he cares for other things than wealth. The question is, shall we all remember this when peace comes again? Though we know that so and so is a rich man, we must ever base our judgments of him by what he does rather than on what he has; and the great hindrance in so exercising our judgment is the reverence for money. The millionaire who amasses wealth for perhaps a posthumous charity is an inferior man to the simple soldier who gains a V.C. Of them, we may well say, "That low man seeks a little thing to do, sees it and does it; the high man, with a great thing to pursue, dies ere he knows it." The reverence for money hides from us our own avarice and the avarice of others; it spreads a fog of

respectability where there ought to be no obscurity at all; it makes us think there is peace where there is war.

One curious fact shows, further, that we do unconsciously reverence money more than the things we buy with it. Thus, you can give a man anything except money without affecting your relations with him. This suggests that money is more sacred than other kinds of material possessions; it is difficult to say why. Possibly, the reason is, that money differs from other possessions in that it is a means of getting them, and that while you have money you keep a power of choice, because you have not chosen. If so, then the stealing of money or the giving of money is a stealing or giving of a power of choice, and this power seems to us more sacred than any of the things that can be chosen. It is a curious attitude, but we reverence undoubtedly the man who has a great deal of this power, partly because he has not yet selected, and partly because he might select well, generously or, as we think, nobly. Unfortunately, the satisfaction of the thought is discounted by the conviction that the man who can ennoble money is not he who is greedy of it, and of the power of choice which it conveys, but he who cares very little for it. One has compared the struggle or greed for wealth to a war; in so thinking, it may do us all good by opening and keeping open our eyes to the nature of the other and material war.

VI.

The conversation at mess one evening drifted to the problem of the waste of manhood in the present war and how it will affect all the nations concerned for a considerable time afterwards. As might be expected, in such an assembly, many of the views and arguments expressed were crude and lacking a clear insight or knowledge of the facts, but the conversation was interesting, if only as an index of how non-medical people were thinking. Naturally, one took a prominent part in the discussion and, afterwards, could not help reflecting upon the subject. As the matter is one which concerns us intimately, it may be useful to others if one outlines the main theme as it presented itself.

We have to recognize that war, with all its horrors, does mankind one service, and that is, it brings them back to realities. It teaches us how thin is our veneer of civilization, and sometimes recalls us to a recollection of matters fundamental to the existence of the State. In primitive communities, even among savages, the care of the children of the clan is bound up with the question of

the defence of the whole tribe. The primitive ruler regards every child as a potential warrior or mother of warriors; hence, even in the rudest tribes, some attention is given to the subject, and even among races which practise infanticide the cruel custom is relaxed in time of war. So, to-day, we in the van of civilization find ourselves as a nation once more considering the old fundamental question from the primitive standpoint. War has awakened us to a need which has too long been neglected, the need of reducing our grievous infant mortality.

So far as Britain is concerned the chief effect of the war will be the depletion of the manhood of the upper and middle classes, because of the selective death-rate among officers. This fact does not involve the view that the future generation will be the children of stay-at-homes and slackers. That view leaves the mothers out of account, and though the men are being killed, the women are not. Of course, to a great extent, the nation must be replenished from the lower orders of society, but after all, that has been happening for a long time. The average number of children in the better families is two, whereas the average family of the casual labourer is six. To keep up the proportion of a particular class, probably an average of four is needed. It is incorrect to assume that a family of two will replace the parents, since allowance has to be made for non-marrying members of these families and the wastage from early deaths. The reasons for the small family system are not merely economic. They are partly physical, arising from the increasing sensitiveness to pain, and are found strongest among the well-to-do. So much has this movement of selfishness spread, that the upper middle classes have been dividing themselves in half since the late 'seventies, and the limitation of families has now reached some of the prosperous artizans. It is curious to observe how certain trades are affected; among some types of skilled workmen we can now look only for small families, whereas men in other occupations, such as miners, are still conspicuous for the full quiver.

Apart from the extension of neo-malthusianism and the false ethics which it postulates, the steady falling of our birth-rate and the impending rise in our death-rate give cause for serious reflection. To appreciate the gravity of the question, we need to realize that the fall in the death-rate, which for a number of years had sufficed to compensate for that in the birth-rate, has now ceased to do so, and it seems only too apparent that a period of definitely lower natural increases than those of even the recent past has commenced.

Since 1901, owing largely to an increased proportion of old people in the population as a result of the decreased birth-rate, the age constitution of the whole population has become definitely less favourable, and as this change progresses it will, to an increasing extent, tend to increase the crude death-rate, and so to diminish natural increase. One often wonders how many people realize how rapidly we are becoming a nation of old people. One is writing without reference to books, but speaking from a fairly accurate memory, it may be accepted as true that, in the decade ending 1911, the population of England and Wales increased by 11 per cent; the population over fifty, however, increased by nearly 21 per cent; this means that the elder people are increasing twice as fast as the whole population. The latest emigration rate is six per thousand, and if this continues with a present birth-rate of twenty-three per thousand, we only require a rise of three points in the death-rate to bring about a stationary population. These are both suggestive and serious facts and, at the present crisis in our history, nothing could be more disastrous than to ignore or soften their meaning; neither can we encourage the view that neo-malthusianism is beneficial to a country, nor that the practice has either scientific support or statistical evidence in its favour. Further, it is unfortunately true that in all our large cities there is an appalling waste of human life, as indicated by an infant mortality rate which shows that 13 per cent of children born die within the first year of life. Clearly the remedy is not to prevent children being born, but to provide a healthy environment for mothers, and to ensure that children are born and reared in wholesome surroundings. Whatever political party may be in power after this war, improvement of the health of the people must be regarded as the most urgent task of the future; apart from other important considerations, our national safety will demand it as compensation for the falling birth-rate. There seems no need for pessimism, but there is a need to look the facts in the face.

To those who may be alarmed about the future, one feels tempted to point out that the elimination of the better social stock is no new phenomenon. The upper classes have always died out, and they represent the best fighting stock. That has happened all through history; it happened during the Wars of the Roses, which practically wiped out the last of the Norman nobility. In the Middle Ages also many of the best intellects of the nation declined parental responsibilities, for they sought the study or the cloister. There is, however, one very important difference from the biological

standpoint between this war and previous wars. The losses of women and children will not be as great. Likewise, disease is so much under control that the mortality from that cause will reach nothing like the same proportion as in the wars of past generations. Further, we must remember that the women are just as capable of transmitting the valuable qualities of the race as the men. Some of the forecasts we have had presented concerning the problems likely to arise from the surplus of women after the War seem exaggerated; personally, one does not think we shall lose half a million men altogether. In all probability, we shall all be poorer after the War, but that may lessen luxury and selfishness, leading to a recovery in the birth-rate, since when people are poorer their families are larger. The question is, how far social tendencies, now prevalent, will continue when the War is over. The encouragement of early marriages and the re-casting of some social and legal ordinances, affecting the status of women, might have a stimulating effect on the birth-rate. These, then, have been one's thoughts; they may be neither profound nor very original, still they may be of use if only they arouse interest in what constitutes a serious and difficult problem for us as a nation. The flower of our manhood is being carried away on the tide of War; it is for us to see that the race continues quantitatively and qualitatively efficient for our imperial needs.

VII.

A perusal of the daily casualty lists and the noting of deaths, both at sea and on land, of intimate and valued friends raises many sad and serious reflections. Some recent personal incidents of the kind have prompted thoughts which may find an echo in the minds of others similarly circumstanced. War on the land leaves the havoc of its passage bitten into the face of the country. We can feel that the earth, mother-like, agonizes with us for a time, though her scars are far sooner healed than our own. It is the way of Nature to forget; she tells us plainly thereby that it is ours, not hers, to remember. Whether we all do remember, is doubtful; perhaps, only for a time. No matter if some do forget; those that do remember can surely ever feel that all those corners of foreign fields, where lie our honoured dead, are in their way so many bits of Britain. For does not that rich earth conceal a richer earth, or rather a dust which our own land bore, shaped and made aware? Surely so, and what is more, can we not think that somewhere in the eternal mind there beats a pulse or vibration which gives back

the thoughts by Britain given? I own that I think so myself, and get some consolation from it.

When we think of those who have met their end in the sea, the application of the same thought becomes more difficult, but should not be so. Our difficulties in respect of the sea and all it has taken lie surely in the fact that drowning by the ocean leaves no vestige upon the scene. We all feel the cold, unconquerable callousness of the sea, which can swallow up so much human life and agony, and yet a moment later lie calm and smiling beneath the sun. It is all so different from the land, whose green or brown waves surge more slowly and, as it seems to us, more mercifully over the scene of our tragedies than the crisp, laughing rollers that close over a "Goliath" or a "Majestic." The lesson Nature teaches here is, that it is ours, not hers, to remember and, curiously enough, sailors have the longest memories of their drowned friends and shipmates. There is more than this to take to heart. Are smooth aspects or smiling promises to lull our race to forgetfulness, once this War is over? Surely, the lesson of the soulless ocean will ever be before us. A day will come when we shall be asked to forgive and forget; but, if we are wise, we shall know that forgiveness is one thing and forgetting another. Even as the sea in a few minutes, and the soil in a season or so, wipes out the evidence of wrong and horror, so the mind of man yields, in due time, to the obliterative influence of Nature. But with the horrors of existing events before us, we must be careful, in so yielding, that we do not abandon too readily the heritage of thought which is our hard-won grip upon the fleeting skirts of Time. The memory of a warfare that knows no sacredness, that kills blindly for results at any cost of honour, and from a mere lust of frustrated dominance, will and must be cherished; not in rancour, but as a safeguard of the future. Even before forgiveness can be thought of, all the reparation that can then be given, alas too late, will be due to humanity and not to ourselves. These thoughts are not the spirit of the earth or land and still less so of the sea, but they are those of human nature betrayed. It is that betrayal which makes the events of our day not to be forgotten or sunk under placid waves with the first promise of clear skies. One writes in a moment of grief and horror, but desirous to see things in due perspective; surely, the true lesson from the sea and land, which cover and hold our dead, is that, before we accept peace, we must be sure that it is not the tropical calm that brews the morrow's storm, and that the perversion of a nation's soul is sunk for ever, not merely submerged.

VIII.

Present circumstances compel one to rise very early and, as a man who for the greater part of life has been accustomed to rise late, one is impressed with the curious new sense of well-being associated with the new habit, and the strange development of a love for the morning which carries with it a feeling of comradeship with birds and animals around. One is not going to write a homily on early rising, but, thinking this over, one is tempted to note how many of us are not only creatures of habit but also victims of certain prejudices in regard to time periods. How many of us enjoy the middle of the night? To most it is a time of anxiety or weariness and associated with a wish to be unconscious of it. Where sleep is concerned, one hour before midnight is supposed to be worth two after it, yet few of us feel that the hours before noon are worth double those which follow between then and midnight. Only a few feel a recurrent sense of pleasure which, to some, seldom fails to accompany their first consciousness of light. The awaking at dawn, to such persons, is as a restoration to life and power and thought, and is associated probably with an unconscious detestation of the dark. This pleasant sense of waking is held to be an index of good health, and most early risers eat a good breakfast. But this class of men are not usually genial or gregarious and, oddly enough, in spite of the cheery outlook with which they contemplate the coming day, their temperamental thermometer falls with the day, and by bedtime they look upon the world with other eyes. Then there is the converse class of man; he who loathes the dawn and, a veritable child of the sunset, is a churl at breakfast. As the day goes on, his fellow-creatures reconcile him to the world. We all know the type and how they want to sit up and put off the moment of going to bed. These people do not seem to care much for life for life's sake, but only for what it has to give. Representatives of these two classes of men live in mess with me now, and one is inclined to think that there is something more civilized and rather higher about the point of view of the man who wakes unhappy but ends his day by finding the world too interesting to leave at orthodox bedtime. That type is undoubtedly a bore and nuisance to the weary, but he is ever with us.

Then, again, there are our little weaknesses and prejudices about days of the week. How many can truly say that Friday is their lucky or favourite day on which to cut their nails or begin an enterprise? I recall a dame who was always called "Friday-

faced Jane," simply because she was sour-looking. Although the week is an arbitrary division of time, free of the subtle influence of the moon, yet most people have a favourite weekday. My wife, for instance, attaches great importance to Tuesday, but what the reason is I have never been able to find out. Few people express a preference for Monday, and generally that day has a bad name. Many have heard of the old joke about the second day in the week being kept as a fast after indiscretions in eating and drinking on the Sabbath. Even the clergy are wont to speak of feeling "Mondayish," as expressing the weariness and reaction following a hard day's series of services on the Sunday, and Kipling has described a headache as a Monday head. Possibly, the modern antipathy to a Monday has been emphasized for many by the circumstance that it is settling day for many household accounts and, to those who indulge in betting, the settling up with a bookmaker for the rash and unrealized anticipations of the previous week. Then there is Sunday itself; a time was when that day was dull to a degree and, even now, in some families marked by a "Friday-faced" gloom. For the many, any bitter gravity attaching to the Sunday belongs to the past, but to the thoughtful the hope exists that the reactionary tendency to liken it to other days has reached a limit. In the present day, it is a day of leisure and pleasure, tempered by opportunities for public worship which are free from any shadow of moral or other compulsion. It breaks the monotony of life for the working classes and undoubtedly exercises a democratic influence, for on that day we don our better clothes and think we all look alike. Again, there is the fact that the majority of people have a good dinner on the Sunday; one cannot help thinking that it might be better if the money, which goes in Sunday clothes and meals, went to improve the quality of some workaday garments or were spent on better daily dinners, but antagonistic to this common-sense view is the prevalent philosophy that it is preferable to be very comfortable sometimes than a little less uncomfortable always. To myself, as a Nature lover, the chief charm of a Sunday lies in the circumstance that the streets are less crowded and the atmosphere is clearer. What this latter fact means will be obvious to all who have lived in a manufacturing area.

Of the months, one's folk-lore knowledge is small, but hardly anyone likes January and very few people have a good word to say for November. Why it should be thought unlucky to marry in May is one of those conundrums yet to be solved. There are

a few people who tell one that they like winter better than summer. To me, they are eccentrics and comparable with those who never feel so happy as when they are sitting snug over the fire and a bitter blast raging outside; those are the type of people who cannot enjoy being at ease unless they are sure that they are more at ease than somebody else. Thinking of seasons makes one think of our own lifetime periods. When we were schoolboys the custom was to assure us that it was the happiest stage of our earthly existence. With a stiff piece of Greek construe staring one in the face, backed by the certain imposition of so many lines to write or memorize, or perhaps a birching if the task were badly done, even the cheeriest and most irresponsible of boys found it difficult to accept unreservedly such a dictum. What do some of us think now? I am not so sure but that some of us in our hearts do now think that, after all, boyhood was our best time. We really had no worries then and had given no hostages to fortune. The verdict in this case will depend largely on individual experiences; probably the greater number will be found to admit that middle age is the best time of life; certainly in calm weather. Unfortunately, the weather of middle age is seldom calm for long together. The summer of life too often resembles the summer of our homeland, and resolves itself into a few fine days and a thunderstorm, but, even so, we are bound to admit that the fine days are very pleasant, almost as pleasant as spring, and only marred by their paucity. Some old men assure us that old age is the happiest time of life; perhaps so, and we can but hope that our own old age may be in accord with that assurance. As to these uncertainties, it is no use worrying; the only thing to do is to do one's best, confident in the belief that the knowledge that one has played the game throughout will bring its own reward.

THE CARRIER PROBLEM AT HOME IN TIME OF WAR.

By EDWARD C. HORT, F.R.C.P.Edin.

With the consent of the Director-General of the Army Medical Service, I have prepared the following sketch of the efforts that have been made in the past year to deal with the carrier problem at home in the Addington Park War Hospital, in so far as it is concerned with the enteric group of diseases.

The original idea in starting this hospital was the provision of suitable accommodation in the country near London for soldiers suffering from acute infective disorders, such as enteric fever, dysentery, and septicæmia; and a vital part of the scheme was the provision of a well-equipped laboratory in which bacteriological examinations could be systematically carried out. In order to give effect to this scheme, three essentials had first to be secured by the Civilian Committee which had been called together for the purpose —the loan of suitable premises, the approval of the Director-General, and the necessary funds.

Subject to certain conditions designed to protect the interests of the legatees, the trustees of the Addington Park property generously placed the Palace and grounds at the disposal of the Committee for the purpose desired. The Director-General at once gave his cordial approval to the undertaking, and the entire cost of maintenance was guaranteed by the War Office, the cost of equipment of the hospital and laboratory being generously defrayed by private subscribers and by the Red Cross Society, on the recommendation, in the first place, of Sir Frederick Treves. Work was therefore at once set in hand, and the necessary staff appointed.

Before the opening of the hospital, however, in December, 1914, with accommodation for one hundred and thirty beds, the Committee were asked by the Director-General if, for the time being, they would consent to admit convalescents of the enteric group (enterics, paratyphoids, dysenterics) instead of acute cases, in order that a search for carriers, and the necessary detention, should be systematically carried out. And for this purpose they were further invited to assume responsibility for additional accommodation to the extent of two hundred beds in huts, the cost of erection, equipment, and maintenance being borne by the War Office.

The Committee without hesitation undertook the desired responsibility, and the Palace accommodation of one hundred and thirty beds was at once taken up by convalescents who were submitted to periodical tests for "carriage." In a few weeks the huts were also ready for occupation, and up to the present date a total number of three hundred and thirty resident convalescents, replaced at intervals by fresh arrivals, have been periodically examined.

In the early days of the War there was no justification for the provision of a much larger establishment than this to cope with possible emergencies. It was important, however, to make the existing accommodation as elastic as possible. Provisional arrangements were therefore made to use Addington as a clearing-house, with external provision for such convalescents as were proved to be innocent of "carriage" after repeated examinations over an average period of from six to eight weeks. This external provision included detention in secondary convalescent homes, where they were detained for a further period of some weeks, during which time the excreta were sent at stated intervals to the Addington laboratory for further examination. If still found to be free, patients were then discharged on furlough. No patients found to be carriers, whether convalescing or convalescent, were sent to these secondary houses. Under an Army Order true chronic carriers are eventually invalided out of the Army and return to their homes. The Medical Officer of Health of the district in which they reside is informed to this effect.

This arrangement of using Addington as a clearing-house, with the secondary convalescent homes as auxiliaries, still under bacteriological supervision, made it possible not only to examine a considerably larger number of cases than would otherwise have been feasible, but also to increase the total period of supervision. The total number that have been passed through Addington in this way is at present about two thousand; and in more recent months the work of the bacteriological department has been considerably increased by the examination of specimens from convalescents who, for one reason or another, have not been through Addington. On the other hand, the work has been greatly assisted by the cooperation of pathologists attached to various hospitals, as regards patients who have been kept under their observation till vacancies occurred at Addington. In all such cases, the search for carriers has been systematically carried out, and we have been regularly kept informed of the results.

The arrangement described, which was only made possible in

many instances by the generosity of private individuals who, in some cases, assumed the entire financial responsibility, and by the invaluable help given by Lady Dudley, as head of the Convalescent Home department of the British Red Cross Society, had, however, certain disadvantages, which were accentuated by the increasing demand for beds. In view of this increased demand, which itself necessitated centralization of existing convalescent homes in the public interest, the Director-General again invited and obtained the consent of the Committee to assume the responsibility for fresh extension in Addington Park. The proposal involved fresh hut accommodation for 350 more beds, in addition to the existing 330, of which, by an arrangement with the Australian Commonwealth, 150 were set aside for the reception of Australian convalescents, the Government of Australia paying for maintenance. In addition, the Director-General proposed that a military depôt should be established in Addington Park to admit one thousand patients, in order to replace the auxiliary convalescent homes hitherto relied on to clear the beds at Addington.

Arrangements, therefore, are now being made on these lines, with the result that in a short time the increased accommodation available, capable of yet further extension, will allow for the reception and detention of approximately 1,700 potential carriers, who will be replaced as fast as the exigencies of the War demand, compatible with safety to the general population.

Instructions based on these considerations and with particular regard to continuance of bacteriological supervision for as long a period as is practicable, have recently been issued by the Director-General.

The following is an abstract of these instructions :—

Acute cases from overseas to be sent direct to the Royal Victoria Hospital, Netley, or to the Military Hospital, Devonport.

Convalescents are to be transferred to Addington Park War Hospital, if accommodation is available. If accommodation is not available they must be sent to suitable auxiliary hospitals (Class B) —(formerly known as "Convalescent Homes")—for four weeks. If found to be free at the end of this time they will be granted furlough, and notifications will be issued to the proper authorities.

Acute cases occurring at home to be treated in isolation hospitals. Convalescents to be sent to Addington. If accommodation be not available there, they may be sent to one of the auxiliary hospitals attached to the hospital, provided they are proved at the time to be free. If carriers, they are to be sent to Addington as soon as fit to travel.

In no case must convalescents be pronounced as temporarily free until three negative examinations have been recorded at intervals of a week.

In all cases of transference to an auxiliary hospital, or of discharge to furlough, the Commandant at Addington must be at once informed, and a nominal roll of all cases, giving the date and address to which they have been dispatched, forwarded at the same time. A copy must also be sent to the War Office. Until the military depôt in Addington Park for the reception of 1,000 additional convalescents is ready for occupation convalescents to the number of 1,200 will be located in Woldingham Camp, and the excreta of these 1,200 will be periodically examined in the Addington laboratory.

The personnel of the medical and bacteriological staffs is as follows :—

MEDICAL STAFF.

Colonel H. J. W. Barrow, A.M.S., *Commandant.*
Sir John Broadbent, Bart., M.D., *Honorary Physician.*
Edward C. Hort, F.R.C.P.Edin., *Honorary Physician.*
W. J. J. Stewart, M.D., *Medical Superintedent.*
O. Polhill Turner, M.D., *House Physician.*

BACTERIOLOGICAL STAFF.

Edward C. Hort, F.R.C.P.Edin., *Director.*
C. E. Lakin, M.D., *Assistant Director.*
T. H. C. Benians, F.R.C.S., *Assistant Bacteriologist.*
W. Collingwood, Esq., *Assistant Bacteriologist.*
Miss Delyell, M.D., *Assistant Bacteriologist.*

The medical and bacteriological staffs have lost through resignation the services of Dr. Williams and of Dr. Elizabeth Lepper.

For the information of those particularly interested in the subject, an outline of the routine adopted in the bacteriological laboratory at Addington is now given.

The results obtained will be issued in the form of a report to the War Office, to whom application will be made for permission to publish in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, at the end of the War, or possibly yearly, together with such deductions for future guidance in the carrier problem as appear to be justified after expert statistical analysis. They will then be handed over, in accordance with an undertaking given a year ago, to the Secretary of the Medical Research Committee, for incorporation, if his Committee so desires, with the medical history of the War.

It should perhaps here be added, that in the interests of the patients themselves, as well as of the local population, every reasonable precaution has been taken since the opening of the hospital to prevent the spread of infection through carriers, whether detected or not, by systematic bactericidal treatment of the excreta and linen. These precautions were adopted after consultation with the Principal Medical Officer of the Local Government Board and the Local Medical Officers of Health. In all cases the fæcal matter has been incinerated in a special form of destructor, the working of which has given excellent results. And the urine has been disinfected in special receptacles containing bactericidal fluid of proved efficiency in the dilutions employed relative to the time limit of exposure. In the case of linen suitable arrangements have been made for its disinfection. In future, owing to the larger numbers of cases requiring bacteriological supervision, the urine will be treated by the application of heat for sufficient periods to ensure destruction of non-spore-bearing organisms. In the hospital and in the huts the men are also instructed in such special methods of personal hygiene as are necessitated by the grouping together in one place of large numbers of convalescents from diseases of the enteric group.

Routine Employed at Addington in the Search for Carriers of the Enteric Group of Organisms.

The following scheme of identification of these organisms is one that I drew up a year ago for general use at Addington, with one or two alterations since added. It is collated from several sources, particularly from Ledingham and Arkwright's classical handbook on the carrier problem in disease, to which, as well as to Semple and Greig's well-known memoirs on the subject, I am also indebted for much valuable information on other aspects of this problem. For the additions to the scheme referred to I am indebted to Dr. Henderson Smith's admirable paper and chart published in the *British Medical Journal* a few weeks ago. In no case has any convalescent examined at Addington been labelled as a carrier unless the incriminated organism has fulfilled in all essential respects the details given in this table under its respective name.

To the list of organisms here given, for which systematic search is made, should be added the *M. melitensis*. The search for evidence of amœbic dysentery has not yet been made part of the routine.

IDENTIFICATION TABLE OF MEMBERS OF THE ENTERIC GROUP.

B. Typhosus (motile)		Paratyphoid group (motile)		Dysentery group (non-motile)
—	..	*B. paratyphosus* A ..	..	*B. Shiga-Kruse.*
—	..	*B. paratyphosus* B ..	..	*B. Flexner.*
—	..	*B. enteritidis* Gaertner	..	*B. Strong.*
—	..	*B. enteritidis* Aertryk ..	..	*B. Y of Hiss.*
—	..	(*B. Morgan* 1).		

Group Characteristics—

(Common also to *B. pestis*, the Pasteurellæ group, *B. pseudo-tuberculosis*, and to the Gram-negative cocci—*M. melitensis*, Gonococcus, *M. catarrhalis*, and the meningococcus of Weichselbaum.)

(1) Pleomorphic.
(2) Gram-negative.
(3) No liquefaction of gelatine.
(4) No production of indol.
(5) No clotting of milk.
(6) No action on lactose, saccharose (inulin, salicin, amygdalin).

Individual Characteristics—

(7) Produce alkalinity in milk, except *B. typhosus*, *B. paratyphosus* A and B. *Strong*, which produce acidity in milk.
(8) Ferment glucose, mannite, dulcite, sorbite, maltose, galactose, lævulose, as follows:—

B. typhosus and *B. strong* ..	Acid in all.
Paratyphoid group, except *B. Morgan*	Acid and gas in all.
B. Morgan 1	Acid and gas in glucose, galactose and lævulose only.
B. Shiga-Kruse	Acid in glucose, galactose and lævulose only.
B. Flexner	Acid in all but dulcite and sorbite.
B. Y of Hiss	Acid in all but dulcite, sorbite and maltose.

(9) Agglutination tests (absorption when necessary): use serum *Y* for *B. Y* and *B. Flexner*.

Exceptions to Group Characteristics—

(1) The gonococcus and the *M. catarrhalis* are not known to be pleomorphic.
(4) Indol is produced by *B. Morgan* 1, *B. Flexner*, *B. Y of Hiss*, and *B. Strong*.
(5) *B. Strong* clots milk late.
(6) *B. Strong* produces acid in saccharose.

Note.—Dulcite, sorbite, galactose, lævulose have been unobtainable in bulk owing to the War. Dulcitol is now being tested as a substitute for dulcite.

In the case of strains of organisms with which from cultural and biochemical reactions a positive serum reaction might reasonably be anticipated, but in which, nevertheless, only negative results have been met with, such strains are not at once rejected. On the contrary, whenever practicable, repeated subcultures are made, if necessary, for a period from seven to fourteen days, and serum tests are again applied before final rejection is recommended. The necessity for this, especially with urinary strains, appears to be generally admitted.

On the other hand, numerous aberrant strains have been met with, which one is not really justified always in rejecting as of no pathogenic importance, but which, under the stress of a strenuous routine, it has not been possible further to examine. Some such strains have been reserved for further study in the hope of the advent of less laborious days.

The *routine for fæcal examinations is as follows* :—

Once a week, if possible, each patient provides a specimen after purgation. Notwithstanding this precaution, the number of solid specimens is surprising. An emulsion is made of the fresh specimen in five cubic centimetres of sterile broth, inoculated with two large loopfuls of material. It is then allowed to stand one hour at room temperature, and a five-inch MacConkey plate is inoculated with a large loopful of the supernatant fluid. From this plate a second is inoculated without recharging, and both plates are then incubated at 37° C. for about eighteen hours. Whenever possible, the plates are warmed before inoculation in order to diminish the amount of condensation water, and to obtain larger colonies than can be obtained in the cold. It is absolutely essential that the surface of the medium when inoculated should be free of condensation water. This we ensure by pouring the medium into warm plates, which, when the medium is set, are dried at 37° C. for some hours.

If possible, in each case presenting colourless or orange-tinted colonies, these colonies are picked off and individually emulsified in lactose litmus peptone water. If after incubation for one night growth has occurred and there is no change of colour, milk, peptone water and the available sugars are inoculated from each lactose tube. If growth has not occurred, or if no change is noted in the lactose tubes, further incubation is allowed. The complete set of sugars is examined after a suitable period of incubation in order to determine the presence of late lactose fermenters and to reject them. The final examination is made in seven to eight days, and subcultures are then made from likely cultures, in order to apply the necessary serum tests on the following day.

Our experience with the actinic rays, recommended by Dreyer on account of their reputed selective inhibition of *B. coli*, has been disappointing, and their use has therefore been abandoned by us, as by other observers. It appears, in fact, to have been unsafe to assume that a laboratory culture will necessarily react in the same way as a culture direct from the fæces, though in the hands of one of us even the former did not yield the results expected. Our experience with Endo's medium, and with malachite green, has so

far not justified us in using either of these media as a routine optimum medium in preference to MacConkey's medium for fæcal examination, though we preserve an open mind as to the possible superiority of brilliant green and other synthetic media not yet fully tested. In the meanwhile, MacConkey's medium is the routine medium for fæcal work.

Before leaving the subject of fæcal examinations, it may be well to observe that we have deliberately chosen to make serum tests the end-point of identification methods, in order to carry out in each case the fullest investigation possible with a view to the study of strains that might prove to differ biochemically from type. In the investigation of acute cases such deliberation is impossible owing to the necessity for early diagnosis. Time in our work, however, is not the primary consideration. Moreover, a negative serum test early applied rather favours rejection of a strain that repeated subculture, the necessity for which has been indicated by biochemical orthodoxy, may eventually show, when a late serum test is applied, to have been only temporarily inagglutinable.

Routine for Urine Examination.

I have elsewhere shown that in the bacteriological examination of urine the time at which the urine is collected is of some importance. And this applies to hæmic infections of the urine in convalescing cases as well as to tract infections in convalescent cases. If, for example, urine be examined which has only recently traversed the renal filter, as in specimens passed during the day after a short interval, the number of pathogenic organisms present per cubic centimetre may be insufficient to allow of their survival when transferred to a solid laboratory medium. On the other hand, if the first specimen after a night's rest be examined, the number of pathogenic organisms present per cubic centimetre is often sufficiently great to survive transference to a laboratory medium.

In the former case, incubation in the bladder has been cut short, and in the latter case incubation in the bladder has been prolonged. Hence the difference in the results obtained.

In other words, the urine in many cases of pathogenic infection is an excellent medium for growth of the organism causing the infection, and I showed by a large number of observations, published in 1914, that by the simple device of incubating the urine in the laboratory for a night before inoculation of the laboratory medium selected as an index of infection, far better results can often be obtained than if this precaution be omitted.

We repeated these observations at Addington a year ago with a small number of urines suspected of containing members of the enteric group, and we found that, examined in this way, the percentage of ordinary carriers in a mixed population of inoculated and uninoculated typhoid convalescents was considerably higher than is commonly believed. This only applied, however, to the convalescing carrier within six weeks or so of his discharge from an enteric hospital, presumably because the degree of hæmic infection was slight, requiring incubation for its intensification. In the case of the convalescent or true chronic carrier with a tract infection, incubation in the laboratory appears to be unnecessary if incubation in the bladder be first allowed, presumably because the degree of tract infection—allowing of free discharge of pathogenic organisms—is considerable. As a routine method, therefore, all the specimens of urine at Addington are incubated, usually for forty-eight hours, in the laboratory before inoculation of the medium selected for picking off colonies. In all other respects, except selection of medium, the procedure of urinary examination and identification is the same as for fæcal examination.

As regards the optimum solid medium for isolation of urinary organisms, we are not yet satisfied. MacConkey's medium in the commonest form of urinary carrier, the convalescing carrier, is certainly too severe a medium, however suitable it may be for isolation from the convalescent or tract carrier. And the fact that the convalescing carrier is commoner than the convalescent carrier, makes this class potentially more dangerous, especially as by the ordinary routine method of examination, without preliminary incubation of his urine, he is more liable to be missed. Even, however, in the case of incubated urine a MacConkey plate will often show no colourless colonies, or even no growth at all, whereas some of the nasgar plates inoculated in parallel will show colonies of non-lactose-fermenting Gram-negative bacilli. For example, forty plates of MacConkey were inoculated from twenty samples of incubated urine, and the same number of nasgar plates were inoculated from the same urine at the same time, in parallel. No less than thirty per cent of the MacConkey plates showed no growth at all, even after prolonged incubation, whilst five per cent of the nasgar plates gave colonies which subsequently proved to be non-lactose fermenters, and all showed growth after one night's incubation. The last fact would suggest that a medium such as nasgar favours the growth of extraneous organisms to such an extent as to make it useless as an isolation medium of pathogenic organisms. In practice this is not the case, since colonies of

organisms of the coli-typhoid group are soon detected with a little experience. And fortunately lactose-fermenting coliform organisms are relatively rare in males convalescing from diseases of the enteric groups. The expense involved is no doubt a serious item. Experiments with agar plates and with casein agar plates have not yet proved satisfactory, and, to repeat, the question of the optimum isolation medium for urinary examination for our convalescents is still *sub judice*, as is also the question of the advisability of enriching the urine with albumen prior to incubation.

Serological Tests.

The routine method employed is macroscopical only. We have recently adopted Dreyer's suggestions of always incubating at 55° C., using his standard emulsions for all Widal reactions, and of using considerable volumes of diluted serum, bacterial emulsion and normal saline. The results so far obtained have been excellent. We do not find the drop method to be of sufficient accuracy for routine use on a large scale. In carrying out a reaction with *B. typhosus* we test the serum in triplicate against this organism, paratyphosus A and paratyphosus B, and we propose to employ Dreyer's method of curve-recording by multiple examinations at stated intervals. This procedure, of course, is not in our case so much for purposes of diagnosis as by a systematic investigation of large numbers of convalescents in terms of Widal's reaction, of obtaining some light on several interesting problems that have emerged from our work. One of these is the question of the effect of inoculation on "carriage" which, in the light of data we have already collected, appears to be favourable. Much further study, however, will be required before any definite statement can be made as to this. As regards Bordet-Durham reactions with strains of organisms isolated from convalescing and convalescent patients, we have used twenty-four hour emulsions heated at 58° C. for one hour. In all other respects the procedure is the same as in the case of Widal reactions. We do not find it necessary to check our macroscopical results by microscopy, because we are not aware that the latter procedure does more than intensify a well-marked end-result already obtained by macroscopy alone.

This, roughly, is an outline of the attempts being made at Addington to deal with the carrier problem, and it is only designed to indicate here in a general way what is being done. Unfortunately, the exigencies of the moment do not permit of a more elaborate statement, which must be reserved for our official report.

SOME EXPERIMENTS ON THE ANTIBODY PRODUCTION IN RABBITS WITH MIXED TYPHOID, PARATYPHOID, AND CHOLERA VACCINES.

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and

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These experiments were carried out with a view to obtaining a prophylactic vaccine against the paratyphoid fevers, and at the same time combining one or more vaccines, so that the number of inoculations necessary should be as few as possible.

This is especially necessary in the Service, and as long as the efficacy of the vaccines is not impaired the protection against the several diseases is likely to be increased, as men will submit to one course of inoculation whereas they are less likely to submit to two or three.

The vaccines used in this series of experiments were typhoid, paratyphoid A, paratyphoid B, given separately; mixed paratyphoid A and B; mixed typhoid, paratyphoids A and B; and mixed cholera and paratyphoids A and B. They were all inoculated subcutaneously. These combinations were chosen as most of the paratyphoid infections are occurring in the Near East. The men are inoculated against typhoid before they leave this country, and are inoculated against cholera after they leave.

Now the protection against typhoid after inoculation lasts from eighteen months to two years, while the protection afforded by cholera vaccine is lost at the end of six months or thereabouts. In the face of this fact it does not seem reasonable to mix these two vaccines together, and so this combination was not experimented on. Another reason for not combining these two is that it does not appear to be advisable to give cholera vaccine until the individual to whom it is being given is likely to be exposed to infection, on account of its short protective period. As the present typhoid vaccine was worked out on the lines of antibody production in animals, it was decided to carry out these experiments on the same lines.

Owing to want of time, due to the ordinary routine work of the vaccine department, somewhat fewer animals were used for the experiments than would have otherwise been the case. This fault was remedied to a certain extent by placing the tests for agglutinins in the 55° C. incubator for the first two hours; this no doubt accounts for the low agglutinin titre produced for *B. typhosus*, and

by adopting Klien's method for estimating the opsonic power of the various sera, the thermo-stabile opsonins only being taken into account was adopted for the same reason. Each vaccine or combination of vaccines was given to two rabbits, and this worked out at fourteen rabbits, which were divided into five groups.

The different sets of rabbits were chosen so that their weights and ages should be as far as possible equal. In each case they were given the same dose of the various vaccines all through the series of experiments. This dose was given not so much with the idea of raising a high antibody production as with the idea of obtaining comparable results from all the vaccines.

Group 1 consisted of six rabbits, two of which received a dose of typhoid vaccine, namely, one cubic centimetre containing 1,000 millions of *Bacillus typhosus*. Two received 500 millions of *B. paratyphosus* A and two 500 millions of *B. paratyphosus* B.

Group 2 consisted of two rabbits, each receiving one cubic centimetre of a mixed vaccine containing 500 millions of *B. paratyhosus* A and 500 millions of *B. paratyphosus* B.

Group 3 consisted of two rabbits, each of which received one cubic centimetre of a mixed vaccine containing 1,000 millions of *B. typhosus*, 500 millions of *B. paratyphosus* A, and 500 millions of *B. paratyphosus* B.

In Group 4 were two rabbits, each of which received one cubic centimetre of a mixed vaccine which contained 3,000 millions of *V. choleræ*, 500 millions of *B. paratyphosus* A and 500 millions of *B. paratyphosus* B.

Group 5 consisted of two control rabbits.

None of the rabbits suffered in any way from the effects of the inoculation.

Agglutinin Formation.

The serum of the pairs of rabbits was pooled, after being kept for twenty-four hours from the time of drawing off the blood.

The emulsion used throughout the experiments was the same in all cases, being a saline emulsion containing 2,000 millions of organisms per cubic centimetre. The agglutinin reactions were estimated by the sedimentation method, the following dilutions being used: 1 in 20, 1 in 40, 1 in 80, 1 in 100, 1 in 200, 1 in 400, 1 in 800, and 1 in 1,000.

The dilutions of sera and organisms were placed in the 55° C. incubator for two hours and finally read at the end of twenty-four hours. The agglutinin formation was first estimated on the fourth day after inoculation. At this time no agglutination was observed

in the sera of any of the rabbits in Group 1, i.e., in the rabbits receiving doses of the vaccines containing *B. typhosus*, *B. paratyphosus* A, and *B. paratyphosus* B, given separately. In Group 2 the serum gave a complete positive reaction with *B. paratyhosus* A in a dilution of 1 in 40 and an incomplete reaction in 1 in 80. With *B. paratyphosus* B there was only a trace of reaction in a dilution of 1 in 20.

CHART I.

	1—20	1—40	1—80	1—100	1—200	1—400	1—800	1—1,000	Remarks
GROUP I.									
B. typhosus—									
4th day ..	—	—	—	—	—	—	—	—	Two rabbits received 1,000 million *B. typhosus* (sera pooled).
7th ,, ..	+	+	—	—	—	—	—	—	—
11th ,, ..	+	—	—	—	—	—	—	—	—
16th ,, ..	*∓	—	—	—	—	—	—	—	* + 1—10.
25th ,, ..	—	—	—	—	—	—	—	—	—
B. paratyphosus "A"—									
4th day ..	—	—	—	—	—	—	—	—	Two rabbits received 500 million *B. para.* A (sera pooled).
7th ,, ..	++	++	++	+	—	—	—	—	—
11th ,, ..	++	±	—	—	—	—	—	—	—
16th ,, ..	++	—	—	—	—	—	—	—	—
25th ,, ..	±	—	—	—	—	—	—	—	—
B. paratyphosus "B"—									
4th day ..	—	—	—	—	—	—	—	—	Two rabbits received 500 million *B. para.* B (sera pooled).
7th ,, ..	++	+	—	—	—	—	—	—	—
11th ,, ..	—	—	—	—	—	—	—	—	—
16th ,, ..	—	—	—	—	—	—	—	—	—
25th ,, ..	—	—	—	—	—	—	—	—	—
GROUP II.									Two rabbits received— 500 million *B. para.* "A." *B. para.* "B." Total 1,000 million organisms (sera pooled).
B. paratyphosus "A"—									
4th day ..	+	+	±	—	—	—	—	—	
7th ,, ..	++	++	++	++	±	—	—	—	
11th ,, ..	++	++	++	+	—	—	—	—	
16th ,, ..	++	++	±	∓	—	—	—	—	
25th ,, ..	++	±	—	—	—	—	—	—	
B. paratyphosus "B"—									
4th day ..	∓	—	—	—	—	—	—	—	
7th ,, ..	++	++	±	±	—	—	—	—	
11th ,, ..	+	+	—	—	—	—	—	—	
16th ,, ..	±	±	—	—	—	—	—	—	
25th ,, ..	—	—	—	—	—	—	—	—	

CHART I.—*continued.*

	1—20	1—40	1—80	1—100	1—200	1—400	1—800	1—1,000	Remarks
GROUP III.									
B. typhosus—									
4th day ..	—	—	—	—	—	—	—	—	
7th ,, ..	++	++	±	±	—	—	—	—	
11th ,, ..	++	+	—	—	—	—	—	—	
16th ,, ..	+	±	—	—	—	—	—	—	
25th ,, ..	±	—	—	—	—	—	—	—	Two rabbits received— 1,000 million *B. typhosus.* 500 million *B. para.* "A." 500 million *B. para.* "B." Total 2,000 million organisms (sera pooled).
B. paratyphosus "A"—									
4th day ..	+	±	∓	—	—	—	—	—	
7th ,, ..	++	++	++	+	—	—	—	—	
11th ,, ..	++	++	++	+	—	—	—	—	
16th ,, ..	++	±	—	—	—	—	—	—	
25th ,, ..	+	—	—	—	—	—	—	—	
B. paratyphosus "B"—									
4th day ..	—	—	—	—	—	—	—	—	
7th ,, ..	±	—	—	—	—	—	—	—	
11th ,, ..	+	—	—	—	—	—	—	—	
16th ,, ..	±	—	—	—	—	—	—	—	
25th ,, ..	—	—	—	—	—	—	—	—	
GROUP IV.									
V. choleræ—									
4th day ..	+	±	—	—	—	—	—	—	
7th ,, ..	++	++	++	++	+	—	—	—	
11th ,, ..	++	++	++	++	++	+	±	—	
16th ,, ..	++	++	++	++	±	±	—	—	
25th ,, ..	++	++	+	±	—	—	—	—	Two rabbits received— 3,000 million *V. choleræ.* 500 million *B. para.* "A." 500 million *B. para.* "B." Total 4,000 million organisms (sera pooled).
B. paratyphosus "A"—									
4th day ..	+	+	∓	—	—	—	—	—	
7th ,, ..	++	++	++	++	∓	—	—	—	
11th ,, ..	++	++	++	++	—	—	—	—	
16th ,, ..	++	++	±	±	—	—	—	—	
25th ,, ..	++	±	—	—	—	—	—	—	
B. paratyphosus "B"—									
4th day ..	+	±	—	—	—	—	—	—	
7th ,, ..	++	++	+	±	—	—	—	—	
11th ,, ..	++	++	+	±	—	—	—	—	
16th ,, ..	++	+	±	—	—	—	—	—	
25th ,, ..	+	±	—	—	—	—	—	—	

CHART I.—Showing the doses of vaccine given in each of the groups, and the agglutination reactions observed on the various days of examination. ++ = a very marked complete agglutination. + = a complete agglutination. ± = an incomplete agglutination. ∓ = a trace of agglutination.

On this day in Group 3, negative reactions were obtained with *B. typhosus* and *B. paratyphosus* B, but a completely positive reaction occurred with *B. paratyphosus* A in a dilution of 1 in 20, incomplete in 1 in 40, and a trace in 1 in 80.

In Group 4, the reaction with *V. choleræ* was complete in a

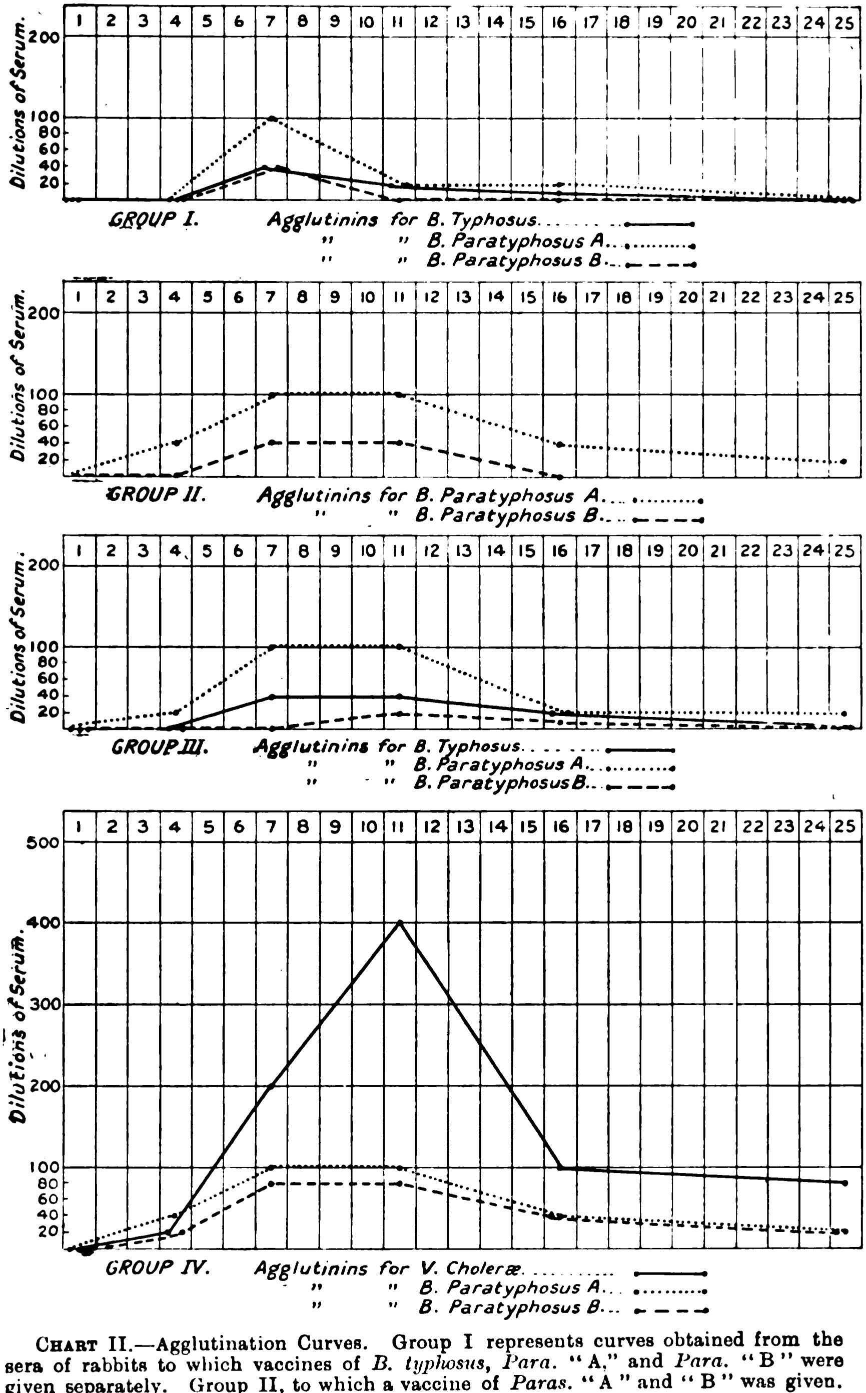


CHART II.—Agglutination Curves. Group I represents curves obtained from the sera of rabbits to which vaccines of *B. typhosus*, *Para.* "A," and *Para.* "B" were given separately. Group II, to which a vaccine of *Paras.* "A" and "B" was given. Group III, to which a vaccine of *B. typhosus*, *Para.* "A," and *Para.* "B" was given. Group IV, to which a vaccine of *V. choleræ*, *Para.* "A," and *Para.* "B" was given. This chart is a graphic representation of Chart I, taking only the completely positive reactions into account. The divisions along the base-line represent days after inoculation.

dilution of 1 in 20, incomplete in 1 in 40. With *B. paratyphosus* A complete in 1 in 40, with a trace in 1 in 80. With *B. paratyphosus* B a complete positive reaction was obtained in a dilution of 1 in 20, incomplete in 1 in 40. Group 5 was negative in dilutions of 1 in 10 and 1 in 20, and remained so throughout the series of experiments. There is no chart shown for this group.

On the seventh day after inoculation it will be noted from Charts 1 and 2 that all the sera gave positive reactions in higher dilutions, except in Group 3 with *B. paratyphosus* B, in which no complete reaction could be demonstrated.

In both groups in which a vaccine against *B. typhosus* was given, the bacillus was agglutinated completely by the serum in dilutions of 1 in 40, i.e., in Groups 1 and 3.

A complete positive reaction was obtained with *B. paratyphosus* A in the case of sera from all groups in a dilution of 1 in 100; in Group 2 there was an incomplete reaction in a dilution of 1 in 200, and a trace was observed in this dilution with the serum from Group 4. With regard to *B. paratyphosus* B, there was a good deal of variation. In Group 1 a complete positive reaction was observed in a dilution of 1 in 40. In Group 2 the reaction was complete in the same dilution and incomplete in dilutions of 1 in 80 and 1 in 100. In Group 3 there was only a trace in 1 in 20, while in Group 4 the reaction was complete in 1 in 80, with an incomplete reaction in 1 in 100. In this group the *V. choleræ* was completely agglutinated by the serum in a dilution of 1 in 200.

Although rabbits inoculated against cholera alone were not included in these series of experiments, this formation of agglutinins corresponds with that obtained with the same dose of the same strains in a vaccine given some weeks ago to estimate the antibody formation in rabbits against cholera. On this, the seventh day, all the sera had reached their highest agglutinating point with the exception of the serum of Group 4, with the *V. choleræ*. The agglutinin production in this case continued to rise until the eleventh day, due, no doubt, to the large dose causing a slower rise to the maximum point. On this day the serum of Group 3 with *V. choleræ* showed a complete positive reaction in a dilution of 1 in 400 and an incomplete reaction in 1 in 800. With *B. paratyphosus* A and B the agglutinin reactions remained the same as on the seventh day as far as complete reaction results were concerned. The results obtained in Group 2 were the same as on the seventh day.

In Group 3, the serum with *B. paratyphosus* A gave the same

results as on the seventh day; the complete reaction to *B. typhosus* remained unchanged, and it agglutinated *B. paratyphosus* B completely in a dilution of 1 in 20.

In Group 1 the serum of all pairs of rabbits gave less marked reaction, and a negative result was obtained with *B. paratyphosus* B. On the sixteenth day a further fall of agglutinins had taken place. The highest positive reactions with *B. paratyphosus* A were found to be present in Groups 2 and 4. On this day with *B. paratyphosus* B the best result was obtained in Group 4, when a positive result was obtained in a dilution of 1 in 40, corresponding with that of *B. paratyphosus* A. In Group 3 a positive result was observed in a dilution of 1 in 10, and negative results were obtained in Groups 1 and 2. With *B. typhosus* a positive reading was obtained in a slightly higher dilution in Group 3 than in Group 2 (see charts 1 and 2). No further estimations were carried out until the twenty-fifth day after inoculation.

In Group 1 at this period no complete agglutination could be made out, except in the case of the rabbits inoculated against *B. paratyphosus* A, which gave a complete reaction in a dilution of 1 in 10.

In Group 2 agglutinins for *B. paratyphosus* B had been lost on the sixteenth day, while on the twenty-fifth day they were present for *B. paratyphosus* A in a dilution of 1 in 40. In Group 3, on this day, there was an incomplete reaction present with *B. typhosus* in a dilution of 1 in 20, but nothing complete. With *B. paratyphosus* A a positive (complete) reaction was present in 1 in 20.

In Group 4 the antibody production still remained the best. Complete positive reactions were obtained with *V. choleræ* in a dilution of 1 in 80, with *B. paratyphosus* A in 1 in 40, and with *B. paratyphosus* B in 1 in 20.

Group 5 (the control group) gave constantly negative results in 1 in 10 and 1 in 20 with all the strains of organisms used.

On reviewing this series of experiments as a whole it may be noted that the curves obtained from the agglutinin production in the serum of rabbits inoculated against *B. typhosus* alone and against *B. typhosus*, *B. paratyphosus* A, and *B. paratyphosus* B were very similar. In the case of the paratyphoids the result is not quite the same. The agglutinin production against *B. paratyphosus* A reached the same point on the same day in all the groups. It fell away most quickly in the case of Group 1, the remaining groups keeping at their highest point until the eleventh day, after which Group 3 fell away faster than Groups 2 and 4.

In the case of *B. paratyphosus* B agglutinins first appeared on the fourth day when the vaccine was given mixed with *B. paratyphosus* A and cholera vaccines. This group eventually gave the highest agglutinin production against *B. paratyphosus* B, and it was sustained for a longer period than in any other group.

Group 2 gave the next highest agglutinin production against this organism, and Group 3 the lowest, in which no agglutinins for *B. paratyphosus* B could be demonstrated until the eleventh day, and then a complete positive reaction was only obtained in a dilution of 1 in 20. The agglutinin production against *V. choleræ* was well marked and sustained. In this series no rabbits were immunized against cholera by giving a cholera vaccine by itself, but a rabbit which received the same dose of cholera vaccine some weeks ago was found at the time to give very much the same agglutinin production.

No group agglutinins could be demonstrated in any of the sera under examination, which fact is important in drawing conclusions from the experiments as a whole.

Opsonin Estimation.

The serum was heated at 56° C. for thirty minutes, and the thermo-stabile opsonins were estimated by Klien's method, the end-point being taken as 0·5 organism per cell. The emulsions of organisms used were standardized to contain 1,000 million per cubic centimetre. The mixture of sera, emulsions, and cells was kept at 37° C. for ten minutes only, so as to lessen the chance of any lysis taking place in the cells.

While opsonins were marked for *B. typhosus* and *V. choleræ*, they were present to a much less extent for *B. paratyphosus* B, and none could be demonstrated for *B. paratyphosus* A.

This difficulty in obtaining opsonins for *B. paratyphosus* A has also been recorded by Cummins and Cumming in the Journal of the Royal Army Medical Corps, vol. xix, No. 4, October, 1912, and vol. xxi, No. 3, September, 1913, the second reference being to the opsonin production in man.

In Group 2 no opsonins could be demonstrated for either *B. paratyphosus* A or B, so no chart for this group is shown.

In Groups 1 and 3 the opsonin production for *B. typhosus* is practically identical, the end-point on the seventh day being reached in a dilution of 1 in 144, that of Group 3 falling slightly sooner than that of Group 1.

In Group 4 the opsonic end-point for *B. paratyphosus* B was

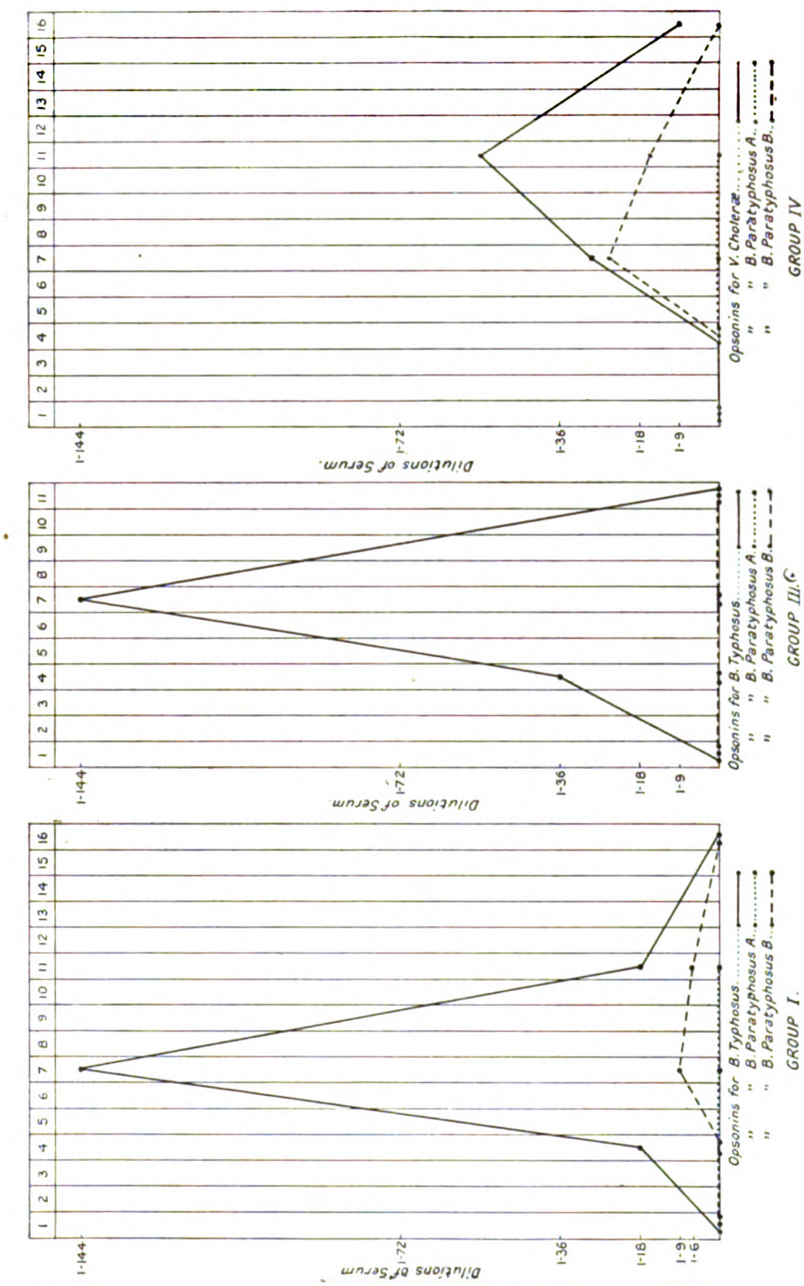


CHART III.—Thermostabile Opsonins (Klien's Method). The groups are the same as in the agglutinin charts. No curve is shown for Group II as no thermostabile opsonins were demonstrable for this group. The end-point represents 0·5 organisms per cell.

reached in a dilution of 1 in 25 on the seventh day, and had fallen away by the sixteenth day, while the highest point for cholera was not reached until the eleventh day.

Our thanks are due to Major C. J. Coppinger for assistance in carrying out the opsonic and agglutination estimations.

CONCLUSIONS.

(1) Groups 2 and 4 give the best results as far as agglutinins go, while Groups 1 and 4 are the best with regard to opsonins.

(2) It must be noted that the dose of the individual vaccines is the same throughout the series of experiments, but in the case of the mixed vaccines the animal received at least double the number of bacilli, and in the case of Group 4 a total of 4,000 million organisms. This would tend to show that the increased antibody production is due rather to an increase of the mass dose than to group antibody elaboration.

(3) Inoculation with paratyphoid vaccines being quite in its infancy, there is no evidence yet obtainable as to the duration of the protection afforded, as the only real way to estimate this is from statistics obtained after inoculation has been adopted. This protection is probably of shorter duration, however, than is the case with typhoid vaccine, and this is an argument for not combining them together.

(4) From the experiments under review the best combination would appear to be that of cholera and the paratyphoid vaccines. It would seem reasonable to suggest that from the Service point of view, the inoculation against typhoid should not be interfered with, and that in districts where the paratyphoid fevers are prevalent a mixed paratyphoid vaccine should be used which, where necessary, may conveniently and advantageously be combined with cholera vaccine, thereby rendering fewer inoculations necessary.

(5) With mixed vaccines it is of utmost importance to keep up the dosage of the individual component parts. If, owing to excessive reaction produced, this cannot be done, the idea should be abandoned. Experiments with the same doses as given to the rabbits in this series are now being carried out in men.

ANALYSIS OF CASES OF TETANUS TREATED IN HOME MILITARY HOSPITALS FROM AUGUST, 1914, TO AUGUST, 1915.[1]

By Surgeon-General Sir DAVID BRUCE, C.B., F.R.S., F.R.C.P.

The object of this paper is to give medical officers serving in military hospitals at home the result of various methods of treatment in cases of tetanus.

In December, 1914, a return of cases of tetanus was called for from home military hospitals, and an Army form issued. Up to the present, notes on 231 cases have been sent in; of these, 98 recovered and 133 died. This gives a mortality of 57·7 per cent. In the "Memorandum on the Treatment of Injuries in War" (July, 1915)[2] it is reported from overseas that 179 cases of tetanus have been treated. Of these 179 cases, 140 died, a case mortality of 78·2 per cent.

The death-rate in untreated cases is stated to be 91 per cent. in those of short incubation, 50 per cent. in those of delayed incubation.

On examining the rate of mortality at the various hospitals where cases of tetanus have been treated, it is seen that at Netley it stands at 81 per cent. This is probably due to the fact that as this hospital is near the port of disembarkation the most serious cases and those already showing symptoms of tetanus would naturally be sent there.

There were six cases at Aldershot with six recoveries. As this result is very satisfactory, it may be useful to describe the method of treatment employed.

Cases of Tetanus treated at Aldershot.

Case 40.—The wound was in the right arm and caused by a shrapnel bullet. Five days after the wound, on his admission to Aldershot Hospital, he had 1,500 units of antitetanic serum injected subcutaneously as a preventive measure. Symptoms of tetanus occurred nine days after this injection, fourteen days after the date of wound. He now had 3,000 units injected subcutaneously and intrathecally on two days. Recovered.

Case 41.—Gunshot wound of middle finger of the left hand. On

[1] Reprinted from the *British Medical Journal*, October 23, 1915, p. 593, ii.

[2] *Brit. Med. Journ.*, August 21, 1915, p. 305.

TABLE I.—PARTICULARS OF THE SIX CASES TREATED AT ALDERSHOT.

Number of case	Date of wound	Prophylactic injection of serum.				Onset of symptoms			Curative treatment by antitetanic serum			
		Date	Number of days after wound	Method	Units	Date	Number of days after wound	Number of days after prophylactic	Date	Subcutaneously	Intrathecally	Result
40	1914 Oct. 18	1914 Oct. 23	5	Subcutaneously	1,500	1914 Nov. 1	14	9	1914 Nov. 2 Nov. 3	— 1,500	1,500 —	Recovered
41	Oct. 18	Oct. 23	5	Subcutaneously	1,500	Nov. 6	19	14	Nov. 6 Nov. 7	— 1,500	1,500 —	Recovered
42	Oct. 18	Oct. 23	5	Subcutaneously	1,500	Oct. 27	9	4	Oct. 27 Oct. 28 Oct. 28	— — —	1,500 1,500 1,500	Recovered
43	Oct. 26	Oct. 29	3	Subcutaneously	1,500	Nov. 5	10	7	Nov. 5	1,500	1,500	Recovered
44	Oct. 25	—	—	—	—	Oct. 31	6		Oct. 31 Nov. 1	— —	3,000 1,500	Recovered
45	Oct. 20	Nov. 2	13	Subcutaneously	1,500	Nov. 5	16	3	Nov. 5	1,500	1,500	Recovered

his admission to Aldershot Hospital he received 1,500 units as a preventive measure. Symptoms of tetanus occurred fourteen days after this injection and nineteen days after wound. Same treatment as in Case 40. Recovered.

Case 42.—Gunshot wound, scrotum and right thigh. He received 1,500 units on admission, five days after wound. Four days after this symptoms of tetanus appeared, and he received 4,500 units intrathecally in three doses on two days. Recovered.

Case 43.—Shell wound in left hip. On admission, three days after wound, 1,500 units were injected. Symptoms of tetanus appeared seven days after this injection, about ten days after the wound; 3,000 units subcutaneously and intrathecally. Recovered.

Case 44.—Gunshot wound, thorax. No preventive dose was given in this case on admission to the Aldershot Hospital. Symptoms of tetanus appeared six days after wound; 4,500 units in three doses, all intrathecally; 1,500 each, two on one day and one the day following. In addition, 2 c.cm. of a 25 per cent. solution of magnesium sulphate were injected into the spinal canal with each injection of serum. Recovered.

Case 45.—Gunshot wound of left hand. A preventive dose of 1,500 units was given on admission and thirteen days after wound. Symptoms three days after this injection and sixteen after wound; 3,000 units in one day subcutaneously and intrathecally. Recovered.

It may be that these cases were slight, and would have recovered spontaneously, but two things must be remarked. In five of the cases a prophylactic dose of serum was given immediately on admission to hospital at Aldershot, and in the curative treatment the direct injection into the spinal canal was always used. In England resort to this preventive use of serum seems to have been rare, and it is suggested that in suspicious cases it seems a sound line of treatment. After onset of symptoms the intrathecal way of approach appears also to be by far the most effective.

At Aberdeen there were three cases with three recoveries. None of these had a preventive dose on admission to the Aberdeen Hospital. One had 147,000 units (140,000 subcutaneously, 4,000 intravenously, and 3,000 intrathecally), another 18,000 units (16,500 subcutaneously, and 1,500 intrathecally), while the third had only 3,000 subcutaneously.

Colchester also had good results—7 cases with 5 recoveries. Here also there was no prophylactic treatment on admission, and nothing noteworthy in the manner of curative treatment.

The Distribution of Cases of Tetanus between August, 1914, and August, 1915.

The first cases occurred in August, 1914, and the following diagram represents as nearly as possible the number of cases which occurred in each month until the following July. It is impossible to show the proportion of cases of tetanus to the number of wounded, as the information is not at present obtainable.

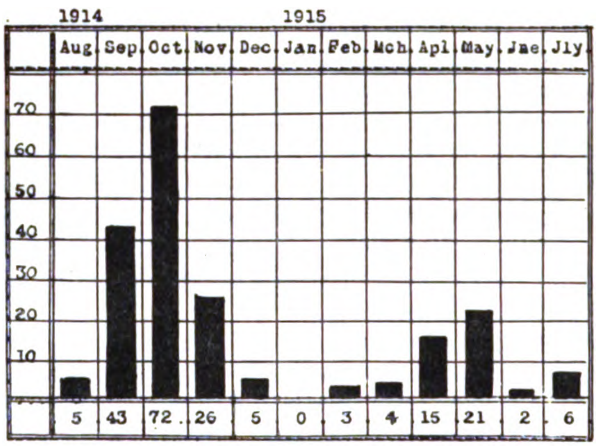


Diagram I.

From Diagram I it will be seen that most of the cases occurred during September, October, and November, 1914. This may have been due to the fact that the wounded were more exposed to contamination of their wounds at that time, which included the retreat from Mons; that there was less opportunity of receiving surgical treatment as rapidly and as effectually as later on; that during this time the preventive use of antitetanic serum had not been developed, as it has during the last six months, when it is reported that, wherever possible, every wounded man has received a prophylactic dose; and generally that experience has taught medical officers how better to cope with the conditions obtaining in time of war, to unlearn the lessons of modern aseptic surgery, and to revert to the older methods of free incisions, thorough drainage, and constant removal of septic products by baths or irrigation.

At the present time it is impossible to say which of these factors has been the most important.

Relation of the Number of Days which elapsed between the Date of Wound and the Onset of Symptoms, and the Rate of Mortality.

It is well known that the rate of mortality depends on the length of time which has elapsed between the date of the wound and the onset of symptoms, and the following diagram shows that the cases of tetanus under consideration follow the same law.

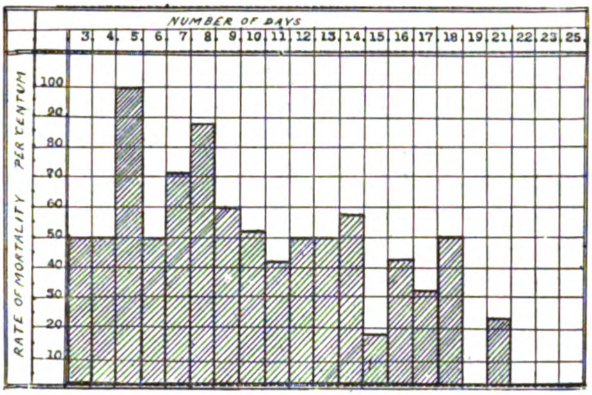
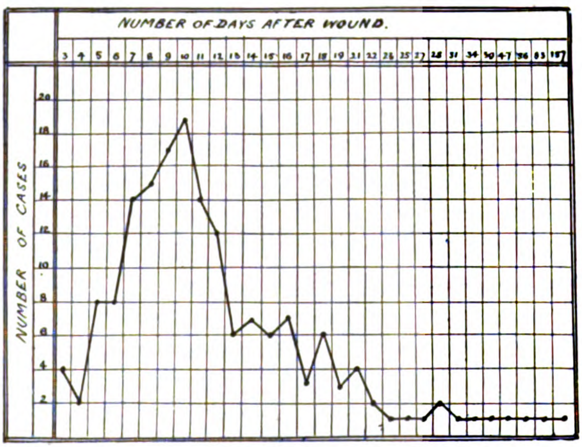


Diagram II.



Curve 1.

Diagram II shows that in the cases dealt with, if the symptoms of tetanus appeared within ten days of receiving the wound, the mortality was 66·6 per cent.; if between the eleventh and twenty-fifth day, 39 per cent.

The Incubation Period, or Number of days which elapse between the Date of Wound and the Onset of Tetanus Symptoms.—The preceding curve shows the number of cases which occurred on each day from the third day after date of wound.

From Curve 1 it will be seen that, in the cases of tetanus under consideration, more occur on the tenth day after the wound than on any other. The incubation period may be as short as three days and as long as 157.

Treatment of Tetanus by Antitetanic Serum.

A.—*Preventive Treatment.*

Among the 231 cases, only 37 are noted as having been treated with antitetanic serum before the onset of symptoms: 20 in France, 7 in England, 10 not specified. Of these 37, 18 recovered and 19 died, giving a mortality of 51·3 per cent.

The usual dose was 1,500 units (8 records), but 1,000 were given in 3, 500 in 2, and 4,000 in 2.

TABLE II.

	Recovered	Died
8 cases inoculated on day of wound	3	5
3 ,, ,, one day after wound	2	1
3 ,, ,, two days after wound	2	1
2 ,, ,, three days after wound	1	1
2 ,, ,, five days after wound	1	1
3 ,, ,, six days after wound	3	0
2 ,, ,, seven days after wound	0	2
1 ,, ,, eight days after wound	0	1
3 ,, ,, nine days after wound	2	1
1 ,, ,, eleven days after wound	1	0
9 cases were unaccounted for.		

The average incubation period of 17 fatal cases was thirteen days; of 15 cases which recovered, 18·5 days.

B.—*Curative Treatment.*

Out of the total of 231 cases the numbers treated with antitetanic serum after the onset of symptoms was 215 (93 per cent.). Sixteen cases did not receive curative treatment with antitetanic serum in England. Of these, 3 recovered and 13 died; mortality, 81·25 per cent. Of the 3 which recovered all had been treated prophylactically in France. Of the 13 who died 6 had been treated prophylactically in France.

Of the 215 cases 116 were treated by subcutaneous injections alone; 46 recovered, 70 died. Mortality, 60·3 per cent.

Of the 215 cases 7 were treated by intravenous injections alone ; 1 recovered 6 died. Mortality, 85·7 per cent.

Of the 215 cases 14 were treated by intrathecal injections alone ; 8 recovered, 6 died. Mortality, 42·8 per cent.

Of the 215 cases 17 were treated subcutaneously and intravenously ; 5 recovered, 12 died. Mortality, 70·9 per cent.

Of the 215 cases 41 were treated subcutaneously and intrathecally ; 23 recovered, 18 died. Mortality, 43·9 per cent.

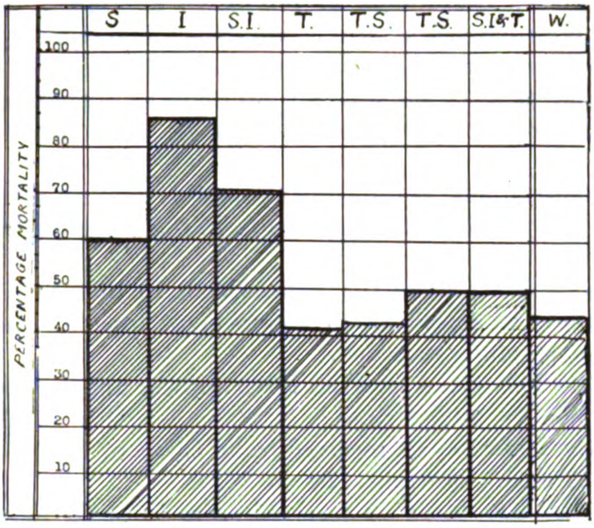


DIAGRAM III.—Treatment of tetanus by antitetanic serum, showing rate of mortality in subcutaneous, intravenous, and intrathecal methods of injection. S., subcutaneous ; I., intravenous ; S.I., subcutaneous and intravenous ; T., intrathecal ; T.S., intrathecal and subcutaneous ; S.I. & T., all three ; W., intrathecal with or without others.

Of the 215 cases 2 were treated intravenously and intrathecally ; 1 recovered, 1 died. Mortality, 50·0 per cent.

Of the 215 cases 16 were treated subcutaneously, intravenously, and intrathecally ; 8 recovered, 8 died. Mortality, 50·0 per cent.

Of the 215 cases 73 were treated intrathecally with or without subcutaneous or intravenous injections ; 40 recovered, 33 died. Mortality, 45·2 per cent.

It would appear from Diagram III, which represents this graphically, that injections of antitetanic serum into the spinal canal are more effective than subcutaneous or intravenous injections.

The Influence of Dosage on the Curative Action of Antitetanic Serum.—It is generally held at the present time that success in the treatment of tetanus by antitetanic serum depends on the use of big doses.

Out of the 231 cases under review, in 200 only was the amount of serum recorded. In analysing these 200 cases it must be noted that the amount of serum given is the total amount, not the daily amount or the amount of each dose. For example, if a serious case came into hospital, received 10,000 units, and died at the end of one day's treatment, this would be put down as 10,000, whereas a milder or more chronic case receiving the same treatment for ten days would be returned as having had 100,000 units. It would be false to argue that as the one got ten times as much serum as the other and recovered, the result was due to the larger amount of serum given.

In the returns sent in the daily amount is seldom given; what is recorded is the total amount given from the beginning to the end of treatment.

It is suggested that in the returns sent in in future the daily amounts should be specified, and the mode of injection, intrathecal or otherwise, carefully recorded.

Out of the 200 cases 4 received 1,000 units or under; 2 recovered, 2 died. Mortality, 50 per cent.

Out of the 200 cases 61 received from 1,001 to 5,000 units; 24 recovered, 37 died. Mortality, 60 per cent.

Out of the 200 cases 50 received from 5,001 to 10,000 units; 14 recovered, 36 died. Mortality, 72 per cent.

Out of the 200 cases 20 received from 10,001 to 15,000 units; 12 recovered, 8 died. Mortality, 40 per cent.

Out of the 200 cases 19 received from 15,001 to 20,000 units; 6 recovered, 13 died. Mortality, 68 per cent.

Out of the 200 cases 19 received from 20,001 to 30,000 units; 10 recovered, 9 died. Mortality, 47 per cent.

Out of the 200 cases 14 received from 30,001 to 40,000 units; 9 recovered, 5 died. Mortality, 36 per cent.

Out of the 200 cases 13 received from 40,001 to 147,000 units; 9 recovered, 4 died. Mortality, 38 per cent.

The main conclusion to be drawn from a study of these cases of tetanus treated therapeutically by antitetanic serum is that it seems highly probable that the serum has little or no effect on the course of the disease. There is a little evidence that, if the serum has any effect at all, then the intrathecal method of injection is the most effective. It hence arises that, if serum is to be used at all, then it

should first and foremost be injected intrathecally in as large a dose as possible, and repeated as often as safe and practicable, as long as symptoms persist. If there is any likelihood that tetanus toxin is still being absorbed into the blood-stream from the wound, then, in addition to the intrathecal injection, a further quantity of serum may be introduced intravenously and subcutaneously. In this way 3,000 to 5,000 units could be injected into the spinal canal and 10,000 to 20,000 into a vein and under the skin.

On account, doubtless, of the ease of giving serum by subcutaneous injection, this method is most used. In 116 cases out of the 215 under consideration (54 per cent.) it was the only method used. In 190 cases (88 per cent.) it was one of the methods used. The intrathecal method was only used in 73 cases out of the 215 (33 per cent.).

Now the contention is that the intrathecal path should be used in every case where serum is used, either alone or in conjunction with the other methods.

Other Therapeutic Remedies.

(1) *Carbolic Acid Injections.*

The treatment of tetanus by carbolic acid injections was described by Baccelli in 1888, and consists of the subcutaneous or intramuscular injection of carbolic acid. It is generally used in a 1 in 20 solution, and from 3 gr. to 12 gr. of the acid constitute a daily dose.

In the present series 33 cases were treated by this drug; 12 patients recovered and 21 died (63.6 per cent.).

In Table III the single injections and daily quantities are expressed in grains of carbolic acid. The cases are arranged according to the amount of carbolic acid given per diem, from 0·45 gr. in Case 75 to 80 gr. daily in Case 206.

From a study of the table it would appear that there is no evidence that carbolic acid has any favourable therapeutic effect on cases of tetanus. It is also suggested that small doses, such as ½ gr. a day, are quite inadequate.

Case 206 received altogether 900 gr. of carbolic acid subcutaneously during a period of twenty-one days. The strength of the solution was 2 per cent. He received 10 gr. every three hours for forty-eight hours, every four hours for ninety-six hours, and every six hours for forty-eight hours; then 20 gr. every twelve hours for nine days, and afterwards every twenty-four hours for three days. At no time were there any symptoms of carbolic acid poisoning. In addition, he had chloral and bromide by the rectum three times

a day, the effect of which was augmented by hypodermic injections of heroin and morphine whenever he was restless. The longest general spasm lasted for about two hours, but throughout the course of the illness the spasms were always well under control; the last occurred fourteen days later than the first. The patient developed tetanus six months after the date of wounding. No focus of infection was discovered.

TABLE III.

No. of case	Single dose, in grains	Quantity per diem, in grains	Total quantity injected	Recovered or died
75	0·45	0·45	2·25 gr. in 5 days	R
92	0·2	0·6	1·2 gr. in 2 days	D
214	0·22	5·2	?	D
51	0·9	5·4	5·4 gr. in 1 day	R
219	0·9	7·2	27·0 gr. in 4 days	D
10	2·6	7·8	?	D
14	0·7	8·4	94·5 gr. in 18 days	R
20	0·75	9·0	18·0 gr. in 2 days	D
223	0·9	10·8	42·0 gr. in 3 days	D
13	1·0	12·0	?	R
229	1·1	13·2	26·0 gr. in 2 days	D
231	2·25	13·5	108·0 gr. in 14 days	R
155	1·35	16·2	24·0 gr. in 1½ days	D
6	1·5	18·0	?	R
9	0·75	18·0	75·0 gr. in 4 days	D
46	0·75	18·0	144·0 gr. in 18 days	R
47	0·75	18·0	?	R
48	0·75	18·0	?	R
50	0·75	18·0	93·0 gr. in 5 days	D
164	1·5	18·0	?	R
225	1·5	18·0	36·0 gr. in 4 days	D
228	1·5	18·0	20·0 gr. in 1½ days	D
16	1·0	24·0	72·0 gr. in 3 days	D
216	1·5	36·0	88·5 gr. in 4 days	D
206	10·0	80·0	900·0 gr. in 21 days	R

(2) *Magnesium Sulphate.*

This method of treatment seems to have been first used in America, and its value depends on its powerful sedative or anæsthetic action on the spinal cord. Few of the cases under treatment in England have received this treatment. One case was given 2 c.cm. of a 25 per cent. solution intrathecally; another, one injection (amount and strength not given) subcutaneously; another received 2 c.cm. of a 25 per cent. solution with each dose of serum intrathecally. Three doses were given, and the patient recovered. Two cases received intrathecal injections, one of them 7 c.cm. of a 25 per cent. solution. In other cases it was given by the mouth and by the rectum, but in these it could not have been intended to

exert its action on the spinal cord. Nine cases in all were treated with magnesium sulphate; of these seven died and two recovered.

It would appear that this method of treatment is powerful and not without danger, so that great caution ought to be used in its exhibition. Stromeyer treated five cases, giving an injection of 8 c.cm. of a 15 per cent. solution. In two of these there was marked anæsthesia of the trunk and lower extremities; in the other three no anæsthesia was noted. In all five cases after the injection there was a cessation of the spasms and muscular rigidity, the patient slept, and respiration was slowed.

Conclusions.

The conclusions to be arrived at by this analysis are as follows:—

(1) In the 231 cases of tetanus under review the mortality was 57·7 per cent.

(2) Cases with a short incubation were more fatal than those of longer incubation.

(3) Most cases occurred on the tenth day after the wound.

(4) There are few allusions to the use of antitetanic serum as a prophylactic.

(5) In regard to the therapeutic effect of antitetanic serum, the evidence would go to show that this action is not well marked.

(6) If antitetanic serum is used—and in such a fatal disease it would seem wrong not to give the patient the benefit, even if doubtful, of the antitoxin—it ought to be injected in the first place intrathecally, as this method would seem to possess advantages over the intravenous and subcutaneous methods.

(7) There is no evidence that any benefit accrued to the cases treated by carbolic acid or magnesium sulphate injections.

(8) To sum up, the treatment of a case of tetanus might be as follows:—

(*a*) Place in a quiet, darkened room under care of a sympathetic and capable nurse.

(*b*) The best surgical treatment of the wound should be thoroughly carried out to ensure the prompt and complete removal of all septic products.

(*c*) The intrathecal injection of at least 3,000 units of antitetanic serum. At the same time 10,000 to 20,000 units may be injected intravenously and subcutaneously. This procedure to be repeated as frequently as the course of the disease seems to demand.

(*d*) In addition to this the patient should receive sedative drugs, such as chloral or chloretone, in full doses.

REPORT ON CEREBROSPINAL MENINGITIS OCCURRING IN THE DORSET MILITARY AREA (EXTENDING FROM CHRISTCHURCH TO TAUNTON) DURING THE PERIOD MARCH TO JULY, 1915.

By Lieutenant ARTHUR COMPTON.
Royal Army Medical Corps.

This report is written on the lines suggested by the Medical Research Committee, most of the headings being taken *verbatim* from the circular issued for guidance by the War Office. Some of the headings, however, have not been dealt with, because through insufficient observations and records I have not felt competent to deal with them. These are the influence in connexion with the mode of spread of the disease of: Particular circumstances of exposure; overcrowding or other hygienic conditions; fatigue; length of service in Army; catarrh as a predisposing factor.

1.—Mode of Spread of the Disease.

General Weather Conditions in relation to the Occurrence of Cases of Cerebrospinal Fever.

In fig. 1 three curves are set forth showing the sunshine, the difference between the maximum and the minimum temperatures expressed as a ratio of the maximum temperature, and the relative humidity of the atmosphere at Weymouth (see Appendix III) daily, from March to June, the four consecutive months when the epidemic of cerebrospinal meningitis of 1914-15 was at its height in this area. On the figure will be found marked the names of all cases of cerebrospinal meningitis, diagnosed bacteriologically, which occurred in Weymouth during the period, sixteen cases, military and civil (including the doubtful case "N."), on a total population of approximately 45,000. These names have been placed opposite the probable date of onset of the disease, in so far as it has been possible to determine this (see Appendix II).

Consider, first, the relative humidity curve of fig. 1. Only a superficial glance at this curve is required to recognize a remarkable coincidence: namely, whenever the curve passes, in a general way, through a maximum value, the occurrence of a case of cerebrospinal meningitis in Weymouth, or its environs, is almost invariably an attendant phenomenon. If this is no mere coincidence, it

indicates that the occurrence of any sudden increase in the degree of saturation of the atmosphere by water vapour may be an etiological factor of no small importance in determining an outbreak of the disease.

For the period in question, the agreement is so striking that could such a curve have been consulted beforehand it would have been possible to predict, almost to a day, the dates when cases of the disease should make their appearance. Some of the cases are of particular interest: "G.," for instance, arrived at the Isolation

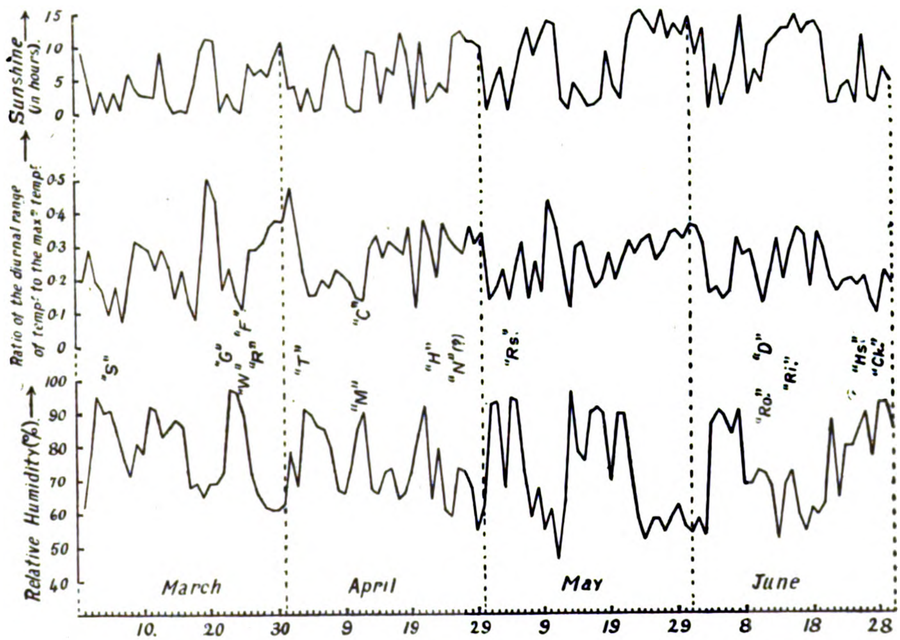


Fig. 1.

Hospital as a suspected case on March 24, with the history of a sudden onset. In his case the onset of the disease can be fixed almost to a certainty as March 23, the date when the highest reading of relative humidity for the months in question was recorded. In G.'s case it is stated that he suffered from a sore throat on March 22 (see Appendix II). Assuming this to be correct—that it was not March 23—and that the throat condition *was due* to the meningococcus, the question arises whether he would still have developed the disease had the sudden degree of saturation of the

air with water vapour which occurred between March 22 and March 23 not taken place. Unfortunately that question cannot be answered; but, if it could, the answer would be instructive. In or about this same date, "W.," "F.," and "R." are to be placed (see Appendix II).

This constant appearance of cases synchronous with a high degree of saturation of the air with water vapour seems to me to occur too frequently *in the above curve* to be a mere chance phenomenon; saturation of the atmosphere with water vapour would appear, therefore, to be a predisposing factor in connexion with outbreaks of the disease, *when the microbe is about.*

The finding is of interest in connexion with an old laboratory observation, namely, that the microbe grows best on solid media only when an abundant supply of moisture is provided; in fact, when the atmospheric conditions inside the culture tube are those of more or less complete saturation with water vapour.

But, in the case of the microbe growing inside the culture tube, another important factor plays a rôle—the temperature of incubation. Assuming that the disease is air-borne, the same should hold true for meningococci floating about in the air, whence they reach the nasopharynx of the susceptible individual, who, under suitable conditions—which it is important to determine—develops the disease. For if the microbe is not present in the air it obviously does not much matter what the conditions of relative humidity and temperature are, as factors to be considered in attempting to explain the occurrence, at any particular season, of cases of the disease.

Consider, in the second place, then, the variations of atmospheric temperature to which the microbe has been subjected during the period in question, by reference to the temperature curve reproduced in fig. 1. This curve expresses for any given day the difference between the maximum and minimum temperatures as a fraction of the maximum temperature.[1]

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[1] Calling the maximum temperature a and the minimum temperature b, the ordinate of the curve is (a-b) /a, i.e., 1-b/ a; which means that each ordinate is a modified expression of the ratio of the minimum temperature to the maximum temperature. The ordinates have been calculated on this principle to facilitate comparison of the temperature curve with the relative humidity curve; thus, when the maximum and minimum temperatures for any given day are nearly equal, the temperature curve passes through a minimum value. If, on the other hand, the simple ratio of the minimum to the maximum temperature had been taken as ordinate the curve would pass through a maximum value whenever these were nearly equal, and such a curve would hardly show up so well on fig. 1.

On reference to this curve a striking coincidence will again be noticed. Cases of the disease make their appearance generally in connexion with minimum readings on the temperature curve; i.e., when the maximum and minimum temperatures are not widely separated, or, in other words, when equable conditions of temperature exist. Equable conditions are, no doubt, favourable to the survival of the microbe in the air; and possibly to its multiplication there. As no cases occur in connexion with maximum points on the curve, wide variations between the maximum and minimum temperatures may reasonably be looked upon as either unfavourable to the life of the microbe in the air, or favourable to its attenuation.

The cosmic factors, then, which would seem to determine outbreaks of the disease—the microbe being about—appear to be sudden saturation of the atmosphere by water vapour, combined with equable conditions of temperature.

In view of this hypothesis, all general maxima on the relative humidity curve and minima on the temperature curve, which are not characterized by the occurrence of cases of the disease, and which might, therefore, at first sight, appear as exceptions to the general rule, are worthy of attention.

Consider in this connexion, first, the general maximum through which the relative humidity curve passes between March 10 and March 16, which, on reference to fig. 1, is seen not to be characterized by any cases of cerebrospinal fever. The temperature curve during this period passes through a maximum value, which indicates that the atmospheric temperature at Weymouth during the period was far from equable, and consequently that the microbe was either entirely absent from the air or present only in an attenuated form. Thus, the hypothesis explains why no cases of the disease occurred in Weymouth at the time. Again, a similar explanation is forthcoming to explain another apparent exception: why no cases should occur to mark the general maximum on the relative humidity curve through which the latter passes between May 12 and May 21. During this period the temperature curve passes—except for the sharp minimum occurring on May 13—in a general way from one maximum value to another, through a comparatively high level minimum. This minimum probably did not correspond to temperature conditions sufficiently equable, which its high level would indicate, to permit of the microbe taking advantage of the generally favourable relative humidity conditions existing at the time. Hence, one finds no cases.

But a word of caution is necessary here. In estimating the force of maxima and minima on the temperature curve it should be noticed that general maxima do not appear, as a rule, to be so important in preventing outbreaks of the disease, as sharp minima —occurring even within general maxima—are in determining the same. A case in point is the general maximum through which the temperature curve passes between April 14 and April 30. This maximum is broken by two sharp minima, corresponding to April 20 and April 23 respectively; and one of these, the latter, is characterized by the case "H." Again, another instance of the same thing is seen in connexion with the case "Ri." This man took ill (see Appendix) on June 14: a date which corresponds to a sharp minimum on the temperature curve, although the general tendency of the curve at the time is upwards, proceeding to the general maximum ultimately attained on June 16.

Only one other important apparent exception on the relative humidity curve remains to be considered: that of the first week of June. And here, again, a simple explanation is forthcoming. Immediately preceding the maximum in question, it will be noticed that the air had for a long period been relatively dry, and the temperature far from equable. According to our hypothesis the meningococcus under these circumstances may be assumed to have disappeared from circulation in the neighbourhood, or, at least, to have become so attenuated as to be non-virulent. Probably the former, for when favourable conditions of humidity and temperature ultimately reappeared, during the first week of June, no cases of cerebrospinal meningitis in Weymouth made their appearance. And yet, only a few days later we find two cases, "D." and "Ro.," and that in connexion with a much less important maximum on the relative humidity curve. How is this to be accounted for? Obviously, by a return of the microbe in a virulent form to the neighbourhood; to explain which either a "carrier" or the wind may be invoked. It is of some moment that both explanations can be supported by fact. The number of "carriers," for instance, found in the district during the month of June was less than that of the other months covered by fig. 1; the laboratory statistics (see Table IV) show only half as many "carriers" for June as for each of the three preceding months. As for the wind, it is of interest that during the first week of June it came chiefly from the west and the north-west, i.e., from the interior of the country, where we know the disease existed at the time; whereas during the dry period which preceded this the prevailing winds were from the sea. It

is easy to imagine how the arriyal of air-borne meningococci in Weymouth at such a time, when the cosmic conditions for them were so favourable, would rapidly lead to a reinfection of the neighbourhood. Thus, "D." and "Ro.," appearing as they do, in connexion with a well-marked minimum on the temperature curve and a transitory maximum on the relative humidity curve, may easily be accounted for. "Ri.," also, occurring as a case only a few days later, although in connexion with a comparatively low level, but otherwise definite maximum on the relative humidity curve, is not surprising.

Thus, all apparent exceptions, from the point of view of one or other curve, when inquired into, are found to support and strengthen the hypothesis rather than detract from it.

To repeat, then, the cosmic factors which apparently determine outbreaks of cerebrospinal meningitis, the meningococcus being about, seem to be sudden saturation of the atmosphere by water vapour, combined with equable conditions of temperature. It remains for further investigation to precise more definitely the force of each; and also to determine how it is that under such conditions the microbe migrates to the meninges.

It would be interesting to know if the data collected from other laboratories bear out this discovery for the Weymouth cases.

Age of the Patient in relation to Incidence of Cerebrospinal Fever.

Of 29 cases (civil and military) occurring in this area (see Appendix I), regarding whom accurate information as to their ages are available:—

4	per cent	occurred	in persons	from	5 to 10	years	of age.
7	,,	,,	,,	,,	10 to 15	,,	,,
17	,,	,,	,,	,,	15 to 20	,,	,,
38	,,	,,	,,	,,	20 to 25	,,	,,
7	,,	,,	,,	,,	25 to 30	,,	,,
10	,,	,,	,,	,,	30 to 35	,,	,,
7	,,	,,	,,	,,	35 to 40	,,	,,
2	,,	,,	,,	,,	40 to 45	,,	,,
5	,,	,,	,,	,,	45 to 50	,,	,,
3	,,	,,	,,	,,	above 50	,,	,,

On plotting the percentage of cases as ordinates, and the corresponding age-periods as abscissæ, these numbers give the graphical representation of fig. 2.

Fig. 2 shows that, for the epidemic of 1915, so far as the Dorset area is concerned, the most susceptible apparent age is between 20 and 25. To get the most susceptible real age the number of cases in each age-period should be referred to the total number of

persons of that age living in the area at the time. It has not been possible for me to determine the most susceptible real age, owing to lack of the necessary statistics.

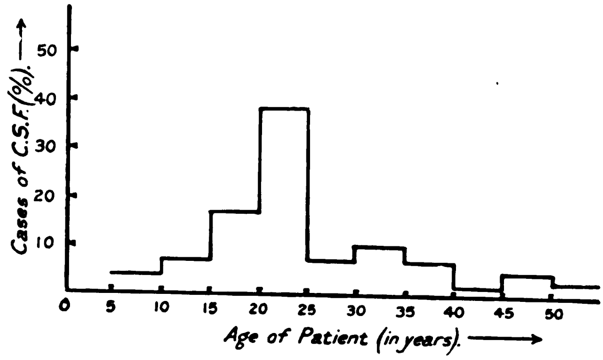

FIG. 2.

II.—CONTACTS.

Identification of the Meningococcus.

In order to answer the question whether I consider the present methods of identifying the meningococcus satisfactory, it will be necessary to consider each of these, a little in detail, from the point of view of the isolation of the microbe from the throats of contacts, and from the cerebrospinal fluid of actual cases of the disease.

To identify the microbe in the case of a "contact" requires three operations, involving the application of, at least, four, sometimes five, tests. These are :—

(1) Cultural appearance.
(2) Microscopic appearance.
(3) Failure to grow at 23° C.
(4) Viability.
(5) Fermentation reactions.

The suspected "case," on the other hand, I have usually diagnosed in one operation by the application of one test (microscopic appearance) to the cerebrospinal fluid; but to confirm the diagnosis, a second operation, involving the application of three, often four, additional tests, was invariably performed. The operations and the tests associated with each stage when searching for the

meningococcus in "contact" and "case" studies, may be summarized diagrammatically as follows :—

Contact :— (1) Swab ⟶ (2) Petri dish culture on serum-agar at 37° C. ⟶ *Cultural appearance ; Microscopic appearance ; Viability.*	(3) Subculture on a tube of serum-agar at 37° C., and on a tube of serum-agar at 23° C. *Failure to grow at 23° C.; Cultural appearance; Viability; Fermentation tests.*
Cases :— (1) Fluid ⟶ *Microscopic appearance.*	(2) Culture on a tube of serum-agar at 37° C., and on a tube of serum-agar at 23° C. *Cultural appearance ; Microscopic appearance : Failure to grow at 23° C. ; Fermentation test ; Viability.*

The general plan of work being set forth, I wish now to consider each of these five tests, somewhat in detail, in order to state what confidence can, in my experience, be placed in them individually and collectively.

Cultural Appearance.—This is usually characteristic : the microbe, from the cerebrospinal fluid of a case, when grown at 37° C. on serum agar, grows in flat, translucent colonies, which become more opaque in the centre as the colonies grow older. In applying cultural appearance, as a method, during the second operation (Petri dish stage) in contact studies, I have frequently mistaken for the meningococcus another microbe, a Gram-negative bacillus, which *grows on serum agar* in translucent colonies very much resembling the meningococcus. So far, then, as a test, cultural appearance does not carry one very far. But not only does this test break down in failing to distinguish the meningococcus from other microbes, it breaks down for the meningococcus itself. I have at present two strains alive: "M." and "G." (see Appendix I), now in the thirteenth and sixteenth generations respectively, which, when first isolated, grew in characteristic translucent colonies, and now grow in small, discrete, opaque colonies, having passed through an intermediate period of growth during several generations in luxuriant, whitish, opaque, heaped-up colonies. And yet, microscopically, these two strains have not changed in morphology ; which shows that a stray infection is not responsible for the cultural variation. The factors concerned are unknown ; prolonged growth on artificial medium (serum agar) may be incriminated, but I think the most likely factor is the composition of the medium, especially its hydrogen ion concentration. This question is being investigated.

Unfortunately I have not had any facility for animal experimentation at Weymouth, and so have not been able to determine if passage through the body of an animal would restore to these two strains their power to grow in translucent colonies.

Microscopic Appearance.—Relying on the microscopic appearance of the microbe as a test does not carry one very far in "contact" studies, since a host of Gram-negative diplococci, which are not generally believed to have anything to do with cerebrospinal meningitis, of which the chief are *catarrhalis, flavus* and *siccus,* all growing on serum-agar at 37° C., are met with in the throats of contacts and normal individuals.

Still, the application of this test, as a method at the second stage of the examination for contacts, effects a considerable "weeding out" of negative contacts; and one has certainly nothing to gainsay about this weeding out. In fact, the microscopic appearance of the meningococcus is its most constant characteristic. The feature on which most reliance can be placed at this stage is, in my opinion, the more or less homogeneous arrangement of the diplococci seen in the microscopic field. Many diplococci, which in the ordinary way one selects from the Petri dish and stains, can therefore be rejected at this stage, as probably not being meningococci, if this characteristic arrangement of the diplococci is not met with on microscopical examination.

Failure of the Meningococcus to grow at 23° C.—This test was mostly relied upon at the third or final stage of the operations carried out to ascertain whether a given "contact" was a "carrier" or not.

As a weeding-out process, the test is most efficient; but the question arises whether it is not too drastic. When first isolated from the cerebrospinal fluid by cultivation on serum agar at 37° C., the meningococcus on being transplanted fails to grow at 23° C., whilst the control grows at 37° C. If this operation is repeated, it will be found that after a number of transplantations at 37° C. the meningococcus is able to grow at 23° C. I have succeeded in doing this with several of my strains: "C.," "G.," "M.," "W.," "H.," all grow to-day at 23° C.

In view of this experimental fact, I am inclined to doubt whether it is wise to reject indiscriminately all Gram-negative diplococci which reach the third stage of the contact examination and are found to grow at 23° C., thereby regarding the contact harbouring them in his nasopharynx as a "non-carrier." This may be stating the matter too strongly, but at any rate *the question arises.*

What, of course, it would be important to determine is whether these strains referred to have lost their virulence in taking on the capacity for growth at 23° C.; also whether on passage through the body of a susceptible animal they would lose their power to grow at 23° C., and regain ability to grow only at 37° C. Unfortunately, as I have already pointed out, animal experimentation has hitherto been out of the question at Weymouth, and I have had to leave the matter there for the present. Of course, if these strains are now avirulent, and were found to remain so after successive passages through animals, that would in itself be interesting.

In the meantime, however, the fact remains: By cultivation on artificial media it is possible to change an originally virulent meningococcus, which did not grow in the first instance at 23° C., into a Gram-negative diplococcus growing at 23° C.; that is, into a microbe which if met with in the throat of a contact, in the ordinary course of an examination for "carriers," would mean that the man from whose throat such a Gram-negative diplococcus came would be labelled as a "non-carrier," and be allowed to mix with healthy individuals. Yet an ancestor of that microbe, only a few generations back, was at work in the central nervous system of an individual stricken with the disease. Who would dare to say that the offspring, in the right environment, should prove to be less virulent than the ancestors?

As a matter of interest the question has arisen in my own experience. A swab from the nasopharynx of the boy F. H. (see Appendix I) was recently sent to the laboratory for examination for the meningococcus, as a preliminary to his being discharged from the Isolation Hospital as cured of the disease. At the second stage of the examination (Petri dish stage: growth, after thirty-six hours at 37° C., from direct inoculation of Petri dish with swab) a Gram-negative diplococcus was met with, which, on transplantation, was found to grow both at 37° C. and 23° C. As I had at this time in the laboratory growing in the eleventh generation the meningococcus originally isolated from his cerebrospinal fluid, I proceeded to compare the two strains (the swab strain growing in the second generation and the C. S. fluid strain in the eleventh generation) by the methods at my disposal.

Táble I shows the result:—

TABLE 1.

	Cultural appearance	Microscopic appearance	Growth at 23° C.	Viability	Fermentation reactions
H. (cerebro-spinal fluid, 17.5.15)/11	Colonies translucent	Gram-negative diplococcus	Grows at 23° C.	Alive after nineteen days on serum agar at 37° C.	Ferments no sugars or glucosides.
H. (swab, 21.6.16)/2	Colonies translucent, slightly opaque	Gram-negative diplococcus	Grows at 23° C.	Alive after nineteen days on serum agar ? at 37° C.	Ferments no sugars or glucosides.

So that, judged by all the methods at my disposal, the two strains—the one in the eleventh generation and the other in the second generation of culture on artificial media—were identical.

In connexion with this question, whether failure to grow at 23° C. affords a satisfactory method for identifying the meningococcus, the following experiment is instructive. Of seventy-four strains of Gram-negative diplococci, growing at 37° C. but not at 23° C., which were obtained in the ordinary course of events from the throats of contacts who were mostly returned as "carriers" of cerebrospinal fever, it was found on a second transplantation of the growth at 37° C. on two tubes and incubation at 37° C. and 23° C. respectively, that:—

		At 37° C.	At 23° C.
46 gave	.. .. ..	+	+
22 ,,	.. .. ..	+	–
6 ,,	.. .. ..	–	–

That is to say, about sixty per cent. of those returned as "carriers" by the first transplantation test would not have been returned "carriers" had they been reported on from the second transplantation. As a matter of fact, what often happened in my early days at Weymouth was, that whenever I obtained, as it seemed to me, too high a percentage of "carriers" amongst any group of men, I frequently transplanted the cultures a second time, with the result that many which were + – gave + + at the second subtransplantation and incubation at 37° C. and 23° C. respectively; so that thus they were not returned as "carriers." My reason for this procedure, then, was that at the beginning I was inclined to be over critical of my own technique; I thought that when no growth occurred at 23° C. it might be because all the culture got rubbed off on the first tube inoculated, and the

second tube was sterile on that account, as both tubes were always inoculated with the same loopful of culture. To guard against this, however, both faces of the loop were smeared in the colony to be subtransplanted and the inoculated tubes were taken haphazard, labelled, and placed in the incubators.

Of course, the explanation of the experiment is to-day evident in the light of what I have already stated about the power of the meningococcus to grow at 23° C., being developed by frequent subculturing on artificial media.

Viability.—In view of the fact that the meningococcus is very short lived when first grown on an artificial medium, this observation can be utilized with advantage in some cases as a method for the identification of the meningococcus. For instance, judged by this principle, the six (— —) readings recorded justify the recognition of the microbe concerned as being the meningococcus, and the meningococcus in the stage of viability usually met with when first isolated from the cerebrospinal fluid of actual cases of the disease. However, as a method, little reliance can be placed on "viability"; for slender viability is no more an essential characteristic of the meningococcus than is "cultural appearance," or "failure to grow at 23° C." In fact, after a few generations of culture on serum agar the life of the meningococcus becomes greatly prolonged. The strains "C.," "M.," "H.," "G.," which I have at present alive can live at least 11, 17, 19 and 22 days respectively between the transplantations.

Fermentation Reactions.—Of the strains now remaining alive in the laboratory only one, the "Ck." strain, shows the fermentation reactions described in the text-books as characteristic of the meningococcus. This strain ferments glucose, also maltose transitorily; but none of the other sugars or glucosides which I have experimented with were fermented by it. The way it ferments maltose is curious: when the culture is examined at the end of twenty-four hours, fermentation is seen to have taken place by the fact that the litmus medium is tinted red, but twenty-four hours later (forty-eight hours in all) the tint is blue, showing that the production of acid has been succeeded by the production of alkali. The fermentation reactions of the different strains "C.," "G.," "M.," "H.," and "Ck.," are being tested from time to time, in view of establishing whether any modification occurs in this direction, analogous to the changes which occur in "cultural appearance," "failure to grow at 23° C.," and "viability." At present the fermentation reactions of these strains are as set out in Table II.

TABLE II.

	Glucose	Maltose	Lactose	Cellose	Saccharose	Glycogen	Salicin
C., /16 ..	+	+	+	0	+	0	0
G., /14 ..	0	0	0	0	0	0	0
M., /12 ..	0	0	0	0	0	0	0
H., /11 ..	0	0	0	0	0	0	0
Ck., /7 ..	+	+	0	missing	0	0	0
Col., /6 ..	0	0	0	0	0	missing	missing

Summary.—In view then of the fact that the meningococcus is far from constant in regard to its "cultural appearance," its "failure to grow at 23° C.," its "viability" and its "fermentation reactions," the conclusion is forced upon me, that the methods at present employed for its identification, in the nasopharynx of contacts, are far from sufficient. But, if that is the conclusion to which the facts—some of them new, and so far as I am aware, stated for the first time—revealed in the foregoing paragraphs lead, their consideration from the point of view of the spread of the disease is even more interesting. In them will be found I think a logical explanation of what has hitherto been a difficult thing to explain: how it is that a microbe so fragile towards antiseptics and short lived as the meningococcus—usually met with in the laboratory, fresh from the cerebrospinal fluid—can be the causative agent of an air-borne disease.

In its power to vary, on prolonged artificial culture, in what have hitherto been considered its more essential characteristics, tending to become more resistant, may lie the explanation of the survival of the microbe in the air, which forms the connecting link between the "carrier" and the susceptible individual. It is highly probable that in the air the meningococcus exists in a more resistant form than that in which it is found in the nasopharynx, or the cerebrospinal fluid, of the "case." Thus, that the "microbe is about" essential to the cosmic hypothesis put forward earlier in this Report may find itself accounted for; indeed, these findings furnish some indirect experimental support to that hypothesis.

III.—Carriers.

Percentage of Carriers in Relation to Overcrowding.

Of the cases of cerebrospinal fever which have come under my observation, 3 occurred in tents, 7 in hospital, 18 in huts, and 7 in houses. On examination of the contacts from these cases, the percentage of "carriers" found was as set forth in Table III.

TABLE III.

Nature of lodgment	Contacts	Positive contacts found	"Carriers." Per cent
Tents	15	0	0
Hospital	210	18	8·6
Huts	500	52	10·4
Houses	52	6	11·5

This table might be taken as indicating that healthy individuals, living in a house, where a case of cerebrospinal meningitis occurs, stands a greater risk of becoming carriers than if the case occurs in a hut; and still greater than if they were sharing the same ward in a hospital; and that the least risk of all would appear to be incurred when the case occurs in a tent.

The Weather in relation to "Carriers."

As weather observations (fig. 1) have been made only for Weymouth, it will be necessary for the present study to separate the Weymouth contacts from those belonging to other portions of my area. Table IV gives the number of "carriers" found in Weymouth for the months in question:—

TABLE IV.

Month	Number of contacts examined	Number of "carriers" found	"Carriers." Per cent
March	239	22	9·1
April	51	8	15·1
May	7	1	14·7
June	91	7	7·7
July	0	0	0

It will be seen, then, that relatively to contacts most "carriers" were found in April and May. The reason for no "carriers" in July is obvious; there was no case, and so there were no contacts to examine. Little importance, however, can be attached to the findings of this table, as the numbers are too small; consequently, it would be unwise to lay much stress on their interpretation in terms of cosmic phenomena.

And yet, the small number of "carriers" in June, shown by Table IV—and confirmed by Table V, for the whole area—is, I think, worthy of notice; for it may possibly be accounted for by the comparatively long period, towards the end of May and the beginning of June, when the air was relatively dry. Moreover the sunshine record for Weymouth in June is fairly satisfactory.

It will be noticed, in passing, that most cases of the disease in Weymouth (fig. 1) occurred in the months of March and June:

a fact in singular contrast with the small percentage of "carriers" for these months.

The Number of "Carriers" in relation to the Stage of the Outbreak.

The number of "carriers" in relation to the season is set out in Table V, which summarizes the results of the examinations carried out in the laboratory since its inauguration in March :—

TABLE V.

Month	Number of contacts examined	Number of "carriers" found	"Carriers." Per cent
March	363	40	11·0
April	352[1]	20	5·7 (or 13·0)
May	38	5	13·1
June	281	17	6·5
July	21	7	33·3

A noteworthy feature of the above table is the small percentage of "carriers" for June. I do not know if this corresponds with the findings for other parts of the country, but, as already pointed out for the Weymouth figures, I cannot help thinking that the period of dry weather which ushered in the month is in some way or other to be held responsible for the result. The finding for July is of no importance; the abnormally large percentage of "carriers" found is to be explained by the fact that only one case occurred in the month, and the numbers appertain to the contacts of that one case.

"Ro.," and "Ri.," two of the cases occurring in June, are of interest from the point of view of the proportion of "carriers" to contacts in relation to the stage of the outbreak. These two cases occurred in the same hut at Bincombe Camp, Weymouth, within a few days of each other, and the contacts were the same for each. The contacts (twenty-nine in number) were swabbed twice, but no "carriers" were found among them. As a matter of fact, however, finding no "carriers" amongst the men of the hut led me to swab the canteen staffs (eight in number), with the result that two "carriers" were found; one in the *dry* and one in the *wet* canteen. These carriers may, of course, belong to any month.

[1] In this number is included 206 prisoners of war, *ex* s.s. "Ascania," examined at the request of the Army Council, regarding whom there is some doubt if they ever were contacts. If this number is deducted from the total number of contacts examined in April, also that of one "carrier," which is all that was found for these 206 men, we get 146 contacts and 19 "carriers." This works out to 13 per cent "carriers" for April.

Age in relation to "Carriers."

Of seven hundred and fifty contacts examined, ranging in age from 16 to 50, Table VI, contains a summary of the proportion of "carriers" to "contacts" found in different age-periods of five years.

TABLE VI.

Age period	Number of contacts examined	Number found positive	Carriers. Per cent
15—20	128	13	10·2
20—25	203	22	10·8
25—30	141	14	9·9
30—35	113	17	15·0
35—40	71	9	12·7
40—45	37	3	8·1
45—50	12	1	8·3

On plotting the percentage of carriers against the corresponding age-periods fig. 3 is obtained.

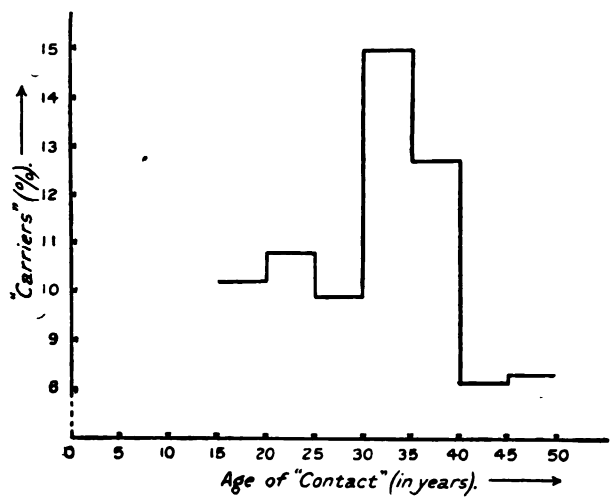

Fig. 3.

This figure indicates that, other things being equal, the liability to become a "carrier" is greatest between the ages of 30 and 35, or even 40. This finding, taken in conjunction with that of fig. 2, which shows that the apparent most susceptible age for developing the disease is between the ages of 20 and 25, points to an interesting inference; since most "carriers" apparently occur at an age so different from that in which most "cases" occur, the "carrier" must be more or less immune. And this is borne out by actual

experience; few observers have found that "carriers" themselves develop the disease. I have not observed any such cases myself. As a matter of interest, I may mention in this connexion that at various times during my stay at Weymouth I have tried by agglutination studies to get some evidence in support of this hypothesis, which, if true, would lead one to expect to find specific antibodies in the serum of "carriers." I have hitherto been unable to detect by the agglutination method any difference between the serum of "carriers" and that of normal individuals. The explanation of this may be that the strain of meningococcus used for the test was not a suitable one. This investigation, however, I propose to take up again at some other time, perhaps under more favourable conditions. It would be interesting to apply the deviation of complement reaction to the solution of the problem.

Is Nasopharyngeal Catarrh common in Carriers?

Of five hundred and eighty contacts, whose throats were carefully examined at the time of swabbing, a more or less unhealthy condition was noted in regard to 106 of them, while the remainder were healthy. The result of the bacteriological examination was as follows:—

	Carriers found	Carriers
106 unhealthy throats	19 ..	17·9.
474 healthy throats	54 ..	11·4.

These figures are consistent with the view that catarrh or other inflammatory condition of the nasopharynx tends to increase the liability of a contact becoming a "carrier" in the proportion of 17·9/11·4=18/12 approx.=3/2; i.e., one and a half times as great.

How long Carriers continue to harbour the Meningococcus in their Nasopharynx.

The number of days which seventy-two individuals, dealt with by me, were found to harbour the meningococcus in their nasopharynx is shown on the next page.

This works out that seventy-two "carriers" retain the microbe conjointly one thousand and ninety-one days, and this notwithstanding treatment. When expressed as an average this gives, per person, about fifteen days.

		Days
1	was found to harbour the meningococcus	4
2	were ,, ,, ,, ...	5
3	,, ,, ,, ,, ...	6
10	,, ,, ,, ,, ...	7
3	,, ,, ,, ,, ...	8
2	,, ,, ,, ,, ...	9
1	was ,, ,, ,, ...	10
5	were ,, ,, ,, ...	11
1	was ,, ,, ,, ...	12
1	,, ,, ,, ,, ...	13
7	were ,, ,, ,, ...	14
8	,, ,, ,, ,, ...	15
3	,, ,, ,, ,, ...	16
1	was ,, ,, ,, ...	17
4	were ,, ,, ,, ...	18
1	was ,, ,, ,, ...	19
5	were ,, ,, ,, ...	20
2	,, ,, ,, ,, ...	21
3	,, ,, ,, ,, ...	22
1	was ,, ,, ,, ...	25
3	were ,, ,, ,, ...	26
1	was ,, ,, ,, ...	31
1	,, ,, ,, ,, ...	32
1	,, ,, ,, ,, ...	34
1	,, ,, ,, ,, ...	37
1	,, ,, ,, ,, ...	38
72		

Treatment of "Carriers."

The treatment recommended in all cases has been the nasal spray and gargle indicated by the War Office (Memo. on Cerebrospinal Fever, February 25, 1915).

IV.—Cases of Cerebrospinal Fever.

Incubation Period.

The only observation at all instructive in this sense, coming under my observation, was that of the two men "Ro." and "Ri" (see Appendix II) living in the same hut at Bincombe Camp. The interval between the sickening of the first and the second case was three days.

Diagnosis.—The diagnosis by bacteriological examination of the cerebrospinal fluid has in the majority of cases been quite trustworthy. In only two cases out of seventeen (twelve per cent approximately) was the diagnosis at first doubtful; and the second lumbar puncture of the two cases in question cleared up the diagnosis.

Specific Treatment.—My opinion in regard to this, based on observation of the patients treated by Captain Barclay, R.A.M.C.(T.) at the Isolation Hospital, Weymouth, is that few cases of cerebrospinal fever need be lost, provided good doses of an efficient antiserum are injected daily in the initial stages of the disease.

APPENDIX.

I.—*List of all Cases of Cerebrospinal Fever dealt with by the Laboratory.*

For convenience the cases are grouped under two headings :—

(1) Cases for which I have personally been responsible for the bacteriological diagnosis (cases occurring in Weymouth, Portland, and Dorchester).

(2) Cases whose cerebrospinal fluids were not sent to this laboratory for examination, the diagnosis being made locally. Only the contacts of these cases were dealt with by me (cases occurring at Bournemouth, Christchurch, Bovington, and Wareham).

IA.—MILITARY CASES WITHIN BOUNDARY OF PORTLAND DEFENCES.

Date of lumbar puncture and diagnosis	Rank and Name	Regiment	Regiment No.	Age	Whether fatal	If so, date of death
17.3.15	Private S. ..	3rd Northants..	17233	47	No	..
24.3.15	Qmr.-Sjt. B.	28th Battalion R.F.A.	21702	33	Yes	1.4.15
24.3.15	Private G. ..	3rd Northants..	10211	19	Yes	30.3.15
28.3.15	,, R. ..	3rd Royal Scots	20448	23	No	..
31.3.15	,, F. ..	,, ,,	20276	29	Yes	7.4.15
31.3.15	,, W. ..	14th ,,	20731	29	Yes	31.3.15
9.4.15	,, T. ..	3rd K.O.S.B. ..	18123	23	No	..
13.4.15	,, M. ..	3rd Wilts ..	9814	22	No	..
13.6.15	,, Ro...	,, ..	19285	21	No	..
15.6.15	,, Ri...	,, ..	19274	21	Yes	16.6.15
30.6.15	,, Ck...	,, ..	20103	19	No	..
4.7.15	,, Hs...	,, ..	19144	36	Yes	12.7.15

IB.—CIVIL CASES DEALT WITH WITHIN BOUNDARY OF PORTLAND DEFENCES.

Date of lumbar puncture and diagnosis	Name	Sex	Age	Whether fatal	If so, date of death
30.4.15	F. H. ..	Male	8	No	..
1.5.15	N.	Female	15	Yes	1.5.15 (diagnosed after death)
7.5.15	R.	,,	34	Yes	9.5.15
7.5.15	C.	,,	13	No	..
17.6.15	D.	Male	45	Yes	16.7.15

Ic.—Dorchester.

Date of lumbar puncture and diagnosis	Rank and Name	Regiment	Regiment No.	Age	Whether fatal	If so, date of death
25.4.15	V.	Prisoner of War	4056	23	No	..
1.6.15	Pte. J. Col. ..	D.C.L.I. ..	19502	21	Yes	2.6.15

IIa.—Wareham.

Date the case occurred as notified to the laboratory	Rank and Name	Regiment	Regiment No.	Age	Whether fatal	If so, date of death
12.3.15	Private P. ..	10th Co. 7 Yorks	13011	20	Yes	1.5.15
11.4.15	Driver Be. ..	93rd R.E. ..	61432	19	No	
2.7.15	Private Mo...	13th Worc. ..	20441	21	Yes	9.7.15

IIb.—Bovington.

Onset.						
16.2.15	Pte. G. A. B.	7th Lincs. ..	11245	19	..	..
19.3.15	,, A. Pe...	7th Bords. ..	16113	20	Yes	25.3.15
7.4.15	Driver E. ..	147th Co. A.S.C.	..	..	..	..
17.4.15	Captain W...	9th D. of Well.	..	21	Yes	8.5.15

IIc.—Swanage.

14.3.15	Gunner Dy...	R.F.A. ..	72165	20	No	..

IId.—Bournemouth District.

15.3.15	H. R. N. ..	Civilian ..	..	33	Yes	17.3.15
20.3.15	Mrs. Ws. ..	,, ..	..	51	,,	13.4.15
28.4.15	Gunner Rb...	43rd Batt. 3c Res. Brig.	65633	19	No	..
1.6.15	Gunner Gw...	R.F.A. ..	71542	37	,,	..
13.6.15	Private Ts. ..	S. Lancs. ..	1457	21	,,	..

II.—*Date of Onset of the Disease for the Weymouth Cases.*

In order to fix as accurately as possible the date of onset of the disease in view of fig. 1 (p. 547), a circular letter was drawn up and sent out to the various patients who had recovered from the disease, or to the relatives, requesting definite information in regard to the following five points :—

(1) What day did the patient first feel ill?
(2) What did he complain of when he took ill?
(3) What was he doing the day before he took ill?
(4) Did he have any sore throat before he took ill?
(5) What day did he first report sick to his Medical Officer?

Answers to the essential questions have been taken more or less *verbatim* from the original letters which are in my possession, and the following table contains a brief *résumé* of the same. Where written statements could not be obtained, as in the case of some of the men who died, the isolation hospital records have been consulted.

TABLE.

Name of patient	Questions asked to fix the date of Onset, with Replies. Authority for the same			
	(1) What day did patient first feel ill?	(2) What did patient complain of when he took ill?	(3) Had patient any sore throat before taking ill?	Authority
Private S.	March 6 to 7 ..	Giddiness, headache, and stiffness of neck	No record	Isolation Hospital Records.
,, G.	,, 22 to 23 ..	Sore throat on March 22; not seen again by medical officer till March 24, when characteristic symptoms of cerebrospinal fever were present; was delirious, and suffered from retention of urine	Yes, see (2)	,,
Qmr.-Sjt. B.	It is not possible to fix the date of onset in this case; history of a very long-standing illness	..	..	,,
Private F.	March 26 ..	Severe rigors on March 26 and 27. Frontal headache on March 28	No record	,,
,, W.	Admitted to hospital on March 27 for influenza	Frontal headache. A petechial rash resembling insect bites was noticed and patient was delirious at night. There was no rigidity	,,	,,
,, R.	March 27 ..	"Headache"	No	Patient's written statement.
,, T.	April 3 ..	Frontal headache and stiffness of neck	No record	Isolation Hospital Records.

TABLE—*continued.*

Name of patient	Questions asked to fix the date of Onset, with Replies. Authority for the same.			
	(1) What day did patient first feel ill?	(2) What did patient complain of when he took ill?	(3) Had patient any sore throat before taking ill?	Authority
Private M.	April 11 ..	Headache, sore throat, stiffness of neck, and "all of a shiver"	Yes, for a week previously	Patient's verbal statement.
,, Ro.	June 11 ..	Felt stiff on the afternoon of June 11. Woke up with headache and sore throat on June 12; also felt giddy	Yes, see (2)	,,
,, Ri.	,, 14 to 15 ..	Came off parade on June 14, not feeling well and complaining of pain in the left testicle. Next morning, he was sick with vomiting, and in a comatose condition	No	Father's verbal statement.
,, Ck.	,, 28 ..	Came off parade on afternoon of June 28. Woke up on the morning of the 29th with a stiff neck, giddiness and sweating	,,	Patient's verbal statement.
,, Hs.	,, 25 to 26 ..	Came off parade on June 25 not feeling well, next morning and subsequent two days he complained of stiffness in back of neck, dizziness, and headache.	,,	Verbal statement of Private W. Franklin.
Mary C...	April 12 ..	Headache, which became so severe as to force her to "take to bed on April 17. After this date nourishment and medicine could not be retained"	"None whatever"	Mother's written statement.
F. H. ..	,, 23 ..	"Sickness, with severe headache and stiffness of the side of the neck"	No	Father's written statement.
F. N. ..	,, 26 ..	"Headache, and on the 27th sickness"	,,	Mother's verbal statement.
E. Rs. ..	May 4th ..	"Very cold, and great pain in her head"	,,	Husband's written statement.
J. D. ..	June 11 ..	"Pains in his back, the back of his neck, and in head"	,,	Wife's written statement.

III.—*Meteorological Data.*

The meteorological readings which follow are from the records kept by J. H. Bolam, Esq., M.Sc., Weymouth, who kindly placed them at my disposal. For the calculation of the relative humidity use has been made of the table given by Marriott ("Hints to Meteorological Observers," London, 1911, pp. 58-60).

MARCH.

Date	SUNSHINE	RELATIVE HUMIDITY			TEMPERATURE		
	In hours	Dry bulb readings in degrees Fahrenheit	Wet bulb readings in degrees Fahrenheit	Relative humidity	Maximum temperature in degrees Fahrenheit	Minimum temperature in degrees Fahrenheit	Range. Maximum temperature
1	9·2	41·9	36·5	62	46·8	37·5	0·199
2	4·5	40·6	37·7	78	48·3	34·0	0·296
3	0·0	48·4	47·8	95	48·9	39·1	0·200
4	3·2	48·9	47·6	90	53·7	44·3	0·175
5	0·2	48·9	47·7	91	51·1	46·1	0·098
6	3·0	47·8	45·6	84	54·8	44·9	0·181
7	0·5	46·9	43·5	76	49·0	45·2	0·078
8	6·0	38·9	35·2	71	43·5	34·5	0·207
9	3·7	34·5	32·6	81	44·4	30·4	0·315
10	2·8	41·0	38·2	78	48·8	34·0	0·303
11	2·5	47·5	46·5	92	56·1	40·0	0·287
12	2·3	44·0	42·9	91	53·4	41·3	0·227
13	9·0	44·0	41·8	83	55·4	39·0	0·296
14	1·8	49·2	47·1	86	54·1	41·1	0·240
15	0·0	47·9	46·3	88	51·5	44·0	0·146
16	0·2	43·0	41·2	86	49·2	38·0	0·228
17	0·0	45·1	40·5	68	48·3	41·8	0·135
18	4·0	45·0	40·5	69	45·2	41·1	0·091
19	9·4	37·4	32·9	65	43·8	32·9	0·285
20	11·0	42·3	38·0	69	52·7	26·2	0·503
21	10·7	46·3	41·8	69	50·8	28·8	0.433
22	0·0	44·8	40·7	72	49·7	41·2	0·171
23	2·9	50·1	49·6	97	55·1	42·1	0·236
24	0·7	49·1	48·5	96	55·1	46·5	0·156
25	0·0	48·6	47·2	89	48·3	43·0	0·110
26	7·2	40·0	36·3	72	45·0	32·0	0·290
27	5·5	37·5	33·1	66	42·8	30·5	0·287
28	6·4	38·4	33·4	62	43·4	30·0	0·309
29	5·2	38·6	33·4	61	42·2	27·1	0·358
30	8·2	36·9	32·2	61	43·4	27·2	0·373
31	10·7	43·8	38·5	63	49·1	31·0	0·369

APRIL.

Date	Sunshine: In hours	Relative Humidity: Dry bulb readings in degrees Fahrenheit	Wet bulb readings in degrees Fahrenheit	Relative humidity	Temperature: Maximum temperature in degrees Fahrenheit	Minimum temperature in degrees Fahrenheit	Range. Maximum temperature
1	3·3	45·7	42·6	78	55·2	29·2	0·472
2	3·8	49·8	44·8	68	51·2	32·8	0·359
3	0·0	46·5	45·3	91	50·4	39·2	0·222
4	3·4	50·1	48·5	89	53·8	45·6	0·152
5	0·0	47·2	45·3	86	50·8	43·0	0·154
6	0·3	47·5	45·4	85	50·0	40·1	0·198
7	7·0	50·0	46·9	79	53·4	44·2	0·172
8	10·0	49·8	44·7	67	53·0	41·1	0·225
9	7·8	48·4	43·1	66	53·1	42·0	0·209
10	0·8	50·0	46·2	74	54·5	44·0	0·193
11	0·0	50·0	47·8	85	52·4	45·0	0·141
12	0·0	51·2	49·8	90	54·4	47·1	0·134
13	9·0	47·0	42·2	67	53·4	38·1	0·287
14	8·5	47·3	42·1	66	56·2	38·0	0·324
15	0·9	50·1	45·8	72	56·9	42·1	0·260
16	6.3	54·5	50·3	73	60·6	42·0	0·308
17	5·2	48·0	42·4	64	54·8	39·0	0·288
18	11·5	51·9	46·4	66	55·1	40·1	0·272
19	8·2	51·9	47·5	72	57·1	37·0	0·352
20	0·1	50·4	48·0	83	52·8	47·2	0·106
21	10·2	47·8	46·8	92	53·8	34·1	0·368
22	1·1	49·9	44·2	64	54·2	37·2	0·314
23	2·0	43·8	41·0	79	51·4	41·6	0·191
24	4·0	51·7	45·3	61	55·2	35·0	0·366
25	2·6	49·6	43·0	59	51·2	35·1	0·314
26	11·0	50·5	46·5	73	60·2	42·8	0·289
27	11·7	49·5	45·3	72	60·2	44·0	0·269
28	10·2	58·3	52·4	67	68·7	44·6	0·351
29	10·1	58·2	49·8	55	64·4	45·1	0·300
30	9·4	59·8	52·7	62	63·0	42·2	0·330

MAY.

Date	Sunshine: In hours	Dry bulb	Wet bulb	Relative humidity	Maximum temperature	Minimum temperature	Range
1	0·0	50·0	48·8	92	53·0	45·1	0·130
2	3·7	53·1	52·0	93	58·0	48·0	0·172
3	6·3	51·4	46·1	67	55·0	42·9	0·220
4	0·0	48·2	47·4	94	50·9	44·0	0·136
5	3·7	51·1	50·1	93	61·2	47·2	0·229
6	8·5	60·8	56·0	72	70·2	49·0	0·302
7	12·1	67·4	59·1	59	63·8	55·0	0·138
8	8·0	63·6	57·4	67	72·0	54·4	0·244
9	10·5	59·7	51·1	55	65·8	45·7	0·154
10	13·1	52·5	46·1	61	67·1	38·2	0·431
11	12·6	63·4	51·8	46	67·1	44·0	0·344
12	1·3	57·2	52·6	73	62·2	48.0	0·228
13	0·0	53·2	52·7	96	54·1	48·6	0·101
14	3·7	44·2	41·1	78	53·2	37·9	0·288
15	2·0	51·1	47·2	75	55·2	38·5	0·302
16	0·3	52·6	50·9	89	56·3	44·0	0·218
17	0·5	53·6	52·3	91	58·8	49·2	0·163
18	1·5	47·9	46·5	89	58·2	47·0	0·192
19	8·4	55·2	50·1	69	56·4	41·0	0·272
20	3·4	56·8	55·2	89	61·2	50·0	0·188
21	1·5	56·9	55·3	89	66·2	50·2	0·242
22	10·6	66·2	61·3	74	75·8	53·0	0·301
23	13·8	67·0	58·5	58	75·0	55·0	0·267
24	14·5	66·8	56·8	52	74·7	52·0	0·304
25	12·7	65·2	56·8	58	75·2	51·0	0·321
26	11·1	71·0	62·1	58	76·1	57·1	0·247
27	14·3	58·6	49·9	54	66·7	48·2	0·278
28	10·3	55·8	48·5	59	61·1	41·0	0·329
29	12·6	60·9	54·1	62	65·0	43·0	0·339
30	10·9	55·2	47·2	56	59·0	40·1	0·310
31	13·7	58·9	50·3	54	61·8	40·0	0·353

JUNE.

Date	Sunshine	Relative Humidity			Temperature		
	In hours	Dry bulb readings in degrees Fahrenheit	Wet bulb readings in degrees Fahrenheit	Relative humidity	Maximum temperature in degrees Fahrenheit	Minimum temperature in degrees Fahrenheit	Range. Maximum temperature
1	8·0	60·2	52·1	58	68·5	45·0	0·343
2	11·8	66·1	56·5	53	67·1	47·1	0·298
3	0·0	53·0	50·9	86	57·5	49·0	0·148
4	6·3	54·2	52·8	90	61·0	50·9	0·165
5	0·2	57·9	56·1	88	61·1	53·0	0·132
6	3·7	58·2	55·8	85	64·0	54·1	0·155
7	7·4	55·0	53·5	90	71·1	49·0	0·311
8	13·5	68·9	62·6	68	73·1	54·0	0·261
9	1·7	65·0	59·2	68	72·1	52·2	0·276
10	5·3	66·1	60 8	72	72·1	58·1	0·194
11	3·6	61·5	56·2	71	65·0	57·5	0·115
12	9·0	61·9	55·8	67	66·0	52·1	0·211
13	10·3	65·1	55·0	52	74·8	51·9	0·306
14	11·5	56·6	51·2	68	64·0	52·1	0·186
15	11·6	56·5	51·8	72	64·9	47·1	0·274
16	13·5	64·8	56·9	59	71·2	46·9	0·341
17	10·7	70·0	60·1	54	73·8	49·2	0·321
18	12·1	61·0	53·8	61	62·3	52·1	0·163
19	12·4	59·7	52·0	59	65·0	44·0	0·323
20	10·7	60·5	53·6	62	63·9	46·0	0·280
21	0·3	56·8	54·8	87	64·3	52·0	0·191
22	0·4	61·6	54·9	64	66·5	56·5	0·150
23	2·7	59·8	56·3	79	64·2	52·6	0·181
24	3·4	56·6	53·6	79	64·4	52·2	0·189
25	0·2	57·9	55·2	84	64·8	54·0	0·167
26	10·3	57·0	55·3	89	64·5	51.9	0·195
27	1·1	62·1	57·9	76	62·3	54·0	0·133
28	0·6	57·3	56·1	92	60·2	55·0	0·086
29	5·5	58·1	56·9	92	67·7	53·6	0·211
30	3·7	60·0	57·3	84	67·1	55·6	0·171

Clinical and other Notes.

A STRIKING CASE OF ORAL SEPSIS.

By Captain ADOLPHE ABRAHAMS.
Royal Army Medical Corps.

During its career of universal popularity, oral sepsis was credited with the capability of causing every ill from which mankind was prone to suffer, from glands in the neck to appendicitis, from simple dyspepsia to pernicious anæmia, from Ludwig's angina to rheumatoid arthritis; from conditions obviously and directly associated with the mouth to conditions for which pathology supplied no clue whatever.

So excessive were the claims advanced for the malevolence of what has been cynically described as the more septic end of the alimentary canal, that the inevitable reaction has resulted in an undue tendency to discredit its influence, particularly as the co-existence of teeth in an indescribable condition with apparently perfect general health is in certain classes of society the rule rather than the exception.

Occasionally a clear case of indictment occurs to remind one that the subject of oral sepsis is by no means to be disregarded so drastically as the swing of the pendulum has induced one to think. The following notes of such a case appear to me to be striking enough to deserve a full description.

Private T. S., aged 30, was admitted to the Connaught Hospital, Aldershot, on July 11, 1915, stating that he had been ill four days with headache, pain in the back, and slight cough, that he had been taken suddenly ill, although he had not vomited nor shivered, and that he had never suffered from any previous illness. On admission his temperature was 102·2° F., pulse 98, respirations 24. The note describes him as a very dark, spare man who has been abroad, but has never had any tropical disease. "Teeth dreadful." There was no evidence of any thoracic trouble, except slightly harsher breathing at the right apex. Leucocytosis, 19,200. There was a slight cough with clear sputum. He was regarded as probably a case of right apical pneumonia.

The note on July 29th states: Intermittent fever has been present since the above, the temperature has been at its highest (102° F. to 103·5° F.) almost every day at 6 p.m., and the pulse rate has risen synchronously. The leucocyte count has varied, between 20,000 and 24,800, the differential count always showing an increase of polymorphonuclear cells. The blood has been examined twice for organisms and on several occasions for the malaria parasite, always with negative result. Large doses of quinine have been without influence. The urine has been twice examined and is sterile. Slight general bronchitis has been

present; repeated examinations of the sputum for the tubercle bacillus have been made with negative result.

For the first half of August he improved as regards his temperature, but from the 14th onwards intermittent fever recurred, with increased pulse frequency and leucocytosis. He appeared to be losing ground more rapidly, and a note on August 25 states that his weight is now only 9 st. 12 lb. (Weight, August 4, 10 st.).

Since his condition pointed beyond any doubt to some form of persistent sepsis, and since the most exhaustive examinations had failed to elicit the slightest information, it seemed reasonable to incriminate the septic teeth as the only possible source. The patient, who had refused early in his illness to undergo dental treatment or to believe that his teeth, which "had never ached in his life," could be the cause of his trouble, now yielded more easily to fresh pressure, and on August 30 five carious stumps were removed. On this day his temperature was 103° F., pulse 116, weight 9 st. 10¾ lb.

On September 3 three teeth were extracted. The temperature remained intermittently raised as before until September 10, and not a little doubt was cast upon the advantage of his dental experiences. But on that day the temperature fell to 97° F., and for the rest of his stay in hospital (until October 2) it never rose above 98° F., the pulse-rate varying considerably from 44 to 92. On September 20 the last seven offenders were extracted.

More striking than the cessation of fever was the general improvement. As stated above, the weight on August 30 was 9 st. 10¾ lb. On September 16 it was 10 st. 4 lb.; on September 23, 10 st. 8¾ lb.; and on September 30, 11 st. The patient, despite obvious masticatory difficulty, "could not get enough to eat."

A final point of interest was the leucocyte count. On August 22 it was 19,000; polymorpho-nuclears, 81·8 per cent. On September 10 28,200; polymorpho-nuclears, 79 per cent. On September 16, 19,200; polymorpho-nuclears, 71 per cent. (Temperature that day 97·4° F.; pulse 64.) On September 21, 27,200; polymorpho-nuclears, 75·1 per cent. (Temperature that day 97·8° F., pulse 60.) On September 28, 11,800; polymorpho-nuclears, 66 per cent. On October 2, 9,000. In other words, the polymorpho-nuclear leucocytosis persisted with gradual subsidence during the completely apyrexial period of his recovery.

I am greatly indebted to Lieutenant-Colonel W. Turner, Commanding Officer to the Connaught Hospital, for permission to publish these notes, and to Lieutenant Cregan, dental surgeon, and to Lieutenant Francis Jones, R.A.M.C., pathologist to the hospital, for their invaluable assistance and for the continued interest they took in this case.

AN UNUSUAL FORM OF PROJECTILE.

By C. HAMILTON WHITEFORD, M.R.C.S., L.R.C.P.
Specialist in Surgery, the Military Hospital, Devonport.

A BOMB, composed of a tin, size five by three and a half inches, covered with cloth, containing mud, gun cotton, a detonator and a fuse, exploded while in the right hand of a sergeant, who was instructing a group of men. The sergeant's hand was blown off at the wrist, and four of the privates were injured.

One man, who had been standing three yards from the sergeant, was admitted to hospital with six lacerated wounds of the right thigh and leg.

The skiagram showed a piece of metal in one wound, and at the sites of the other wounds were dark blotches attributed to the in-driven mud.

From a small wound on the outer side of the knee there was a free flow of synovial fluid. From another wound on the outer side of the knee-joint were removed portions of mud and small masses of bone, the size of a pea, portions of which were covered with articular cartilage, the nodules of bone being held together by strips of fibrous tissue.

Although the portions of bone did not resemble any part of the knee-joint, it was at first feared that this might have been injured.

Among the muscles in the middle of the thigh were found similar nodules of bone with pieces of trousering, and similar foreign bodies were removed from the upper thigh.

In the two latter situations, it was obviously impossible for nodules of bone capped with cartilage to have been detached from the patient.

Further inspection of the nodules and their connexions of fibrous tissue showed them to be comminuted joints from the sergeant's hand.

NOTES ON A CASE OF TETANUS OF SHORT INCUBATION PERIOD, WITH RECOVERY.

By Captain R. LESTER SCOTT.
Royal Army Medical Corps.

THE sudden development of tetanic seizures following operative treatment on a wound incurred five days previously is sufficiently rare to warrant publication.

The patient, Lieutenant ——, was wounded on July 23, 1915. He was admitted to a Base Hospital on July 25, suffering from a circular punched-out wound on the anterior aspect of the left thigh, about the middle third, of the size of a 4s. piece. The wound was caused by the accidental discharge of a flare pistol.

Wounded July 23, 1915.

Month and date	Temperature	Pulse	Serum therapy	Carbolic acid	Sedatives	Spasms	General condition
Admitted, 25.7.15	101·8°	92	.. .. ..	..	.. ..	.. ..	.. ..
Operation, 26.7.15	100·2°	84	.. .. ..	..	.. ..	.. ..	.. ..
Onset, 28.7.15	102·4°	136	Subcutaneous, 1,500 units, 10 a.m. Intrathecal, 4,000 units, 6 p.m. Intravenous, 16,000 units, 10 p.m.	2 c.c. 5 per cent., two-hourly. Subcutaneously	Potassium bromide, 15 gr., and chloral hydrate, 10 gr., two-hourly; morphia, ¼ gr. at night	Fibrillations of affected extensors in the morning every fifteen to twenty seconds. Extended to trismus, rigidity of the neck and violent spasms of affected extensors by evening	Patient unable to flex neck, and only able to open mouth ½ in.
29.7.15	101·8°	136	Intravenous, 15,000 units, 10 a.m; 6,000 units at 10 p.m.	Ditto	Potassium bromide and chloral changed to morphia at night	Severe spasms every one to three minutes	Opens mouth about ¼ in. Takes fluid nourishment well under opiates and sedatives.
30.7.15	101·4°	120	Intrathecal, 4,000 units; intravenous, 6,000 units	Ditto	Potassium bromide and chloral every two and a half hours	Spasms not quite so severe	Does not shout out with pain as formerly. Dozes fairly well, but wakes after a specially strong contraction. Is quite rational when awake. Bowels moved after an enema.
31.7.15	99·0°	120	Intramuscular, 4,000 units, 10 a.m. and 6,000 at 10 p.m. Intrathecal, 3,500 units at 10 p.m.	Ditto	.. ..	Risus continuous. Contractures about every five minutes. Severe contractures about every half hour	Macular rash on chest and abdomen. Opens mouth ½ to ¾ in. No carboluria. Feels better.
1.8.15	100·4°	112	Intramuscular, 6,000 units	2 c.c. 5 per cent. four-hourly	Chloral and Potassium bromide three doses during the day. Morphia at night	Less severe and about every half hour	Sleeps well. Bowels opened with an enema.

2.8.15	99·0°	102	Intrathecal, 3,500 units Subcutaneous, 6,000 units	Ditto	..	Slight spasms and pain, controlled by sedatives	Covered with macular eruptions.
4.8.15	99·6°	92	Subcutaneous, 5,000 units	Discontinued	No bromides or chloral all day	No spasms or twitchings	Complains of "seeing objects," probably due to accumulative effect of large doses of potassium bromide and chloral. Moves about in bed without aid.
7.8.15	99·0°	92	Subcutaneous, 3,000 units	..	During the 5th and 6th no bromides or chloral given, $\frac{1}{4}$ gr. morphia at night. During 7th two doses of sedatives given	Muscular contractions very much lessened. They do not wake patient while asleep	Same.
9.8.15	98·4°	96	Subcutaneous, 2,000 units	..	$\frac{1}{4}$ gr. morphia given since 7th	No spasms or twitchings since 7th	Opens mouth better.
12.8.15	98·4°	92	Subcutaneous, 2,500 units	..	Occasionally at night morphia, $\frac{1}{6}$ gr. given to secure sleep	No further twitchings or spasms	Hallucinations stopped.
14.8.15	99·0°	100	Subcutaneous, 3,000 units	..	Ditto	Frequent spasmodic contractions in left extensors, throwing momentarily rest of body into same condition	Has complained of pain in the wound. Recurrence of spasms, but not nearly so severe. Slight diarrhœa.
15.8.15	98·2°	92	Subcutaneous, 3,500 units, 10 p.m.	..	Very occasionally 6 gr. morphia given	Several sharp spasmodic seizures, occasionally calling out with pain	Wound looking healthy. Very little discharge. Opens mouth wider. Takes fluid nourishment well. Diarrhœa stopped.
17.8.15	98·8°	88	.. .. ..	..	None	Severe contractures ceased. Only a few twitchings in wounded leg	Had a very good day. Sleeps well.
20.8.15	97·8°	96	Subcutaneous, 1,500 units	..	None	No twitchings	Beginning to take solid food. Much better. Sleeps well at night.
Discharged 3.9.15	..	..	.. .. ..	..	.. ..	No spasms since August 15, 1915	Can walk without aid. Risus disappeared. Wound nearly healed. Opens mouth to nearly full extent. Can take solid food.

The temperature on admission was 101·6° F. The wound was foul, discharging pus, and on pressure much gas was liberated. There was tenseness to the extent of two to three inches around the wound. The skin here had a brownish appearance.

Operation August 26, 2 p.m. The wound was enlarged and five pieces of revolver fuse were extracted. Necrotic tissues were cut away as far as possible.

August 28, 9 a.m. The patient complained of pain in the wound and "jerkings" in the affected limb. On examination there were only fibrillations to be seen in the exposed muscles at the site of the wound. These fibrillary contractions took place about every thirty seconds. There were no other symptoms to be noted. Temperature was then 99° F., pulse 114. There was no reliable evidence that a prophylactic dose of anti-tetanus serum had been administered, so one thousand five hundred units were at once given subcutaneously into the abdomen.

By 6 p.m., when patient was again seen, definite symptoms of tetanus had supervened. Clonic spasms took place every few seconds in the affected limb, throwing the rest of the body into rigid contraction. There was slight opisthotonos and the muscles at the back of the neck were stiff. Trismus was marked. Patient shouted with pain at every seizure, and with difficulty his mouth could be opened half an inch.

It is thus evident that the initial symptoms commenced about thirty hours after the operation and five days after the patient was wounded.

The accompanying table shows the effect and the result of pushing the serum treatment. The temperature and the pulse-rate recorded are the highest during a period of twenty-four hours. The total amount of serum administered was 102,000 units. The intravenous and intrathecal administrations of the serum were given under chloroform anæsthesia.

It seems more than probable that the operation laid bare fresh tissues, and there resulted rapid absorption of toxins which had been already elaborated in the necrotic area.

During the whole course of the disease there was no carboluria, albuminuria, or necrosis of tissues. There was no paresis or paralysis of the cranial or any other nerves. The wound on discharge of the patient was practically healed, and he was so far convalescent that he was able to walk.

The interesting features of the case briefly summarized are as follows:—

(1) The incubation period was short.

(2) There is no doubt that the operative interference some days after wound infection had a definite effect on both onset and severity of the attack.

(3) There is equally no doubt that the attack was a severe one, characterized by clonic and tonic seizures associated with great pain.

(4) The essence of the treatment consisted in the adoption of immediate, persistent, and almost extravagant serum therapy.

(5) The result of the treatment was an uncomplicated recovery, with entire absence of secondary lesions.

TRANSMISSION OF MALARIA IN NORTHERN FRANCE.

By Captain J. H. DIBLE.
Royal Army Medical Corps.

The presence of malaria-infected persons in the area occupied by British troops in Northern France raises the question of the likelihood of transmission of the disease to uninfected subjects living in the same districts. The cases quoted below show that such transmission can and does occur.

Both of these cases were sent from the Front to a base hospital. In neither case had a diagnosis of malaria been arrived at when they were admitted here.

Case 1.—Private O., Black Watch, was taken ill whilst in the trenches with his battalion about a fortnight prior to his admission. He complained of pains in the head, general malaise, and attacks of shivering; also of pain in the left side over the splenic area. The symptoms first commenced at about mid-day, and recurred daily, starting with chilliness and shivering, which was later followed by sweating and amelioration of his condition. He was admitted to this hospital as a case of indeterminate pyrexia; an accompanying temperature chart showed periods of pyrexia occurring at about 2 to 3 p.m. daily; on three occasions rigors had been noted. He complained of pain over the splenic region, but the organ was not palpable. The history was thus that of a typical quotidian fever.

On the day of admission (August 26) he had a rigor at noon, and at 2 p.m. his temperature stood at 104·6° F. Blood-films taken at this time showed the presence of numerous malarial parasites, mostly moderately grown plasmodial forms, with scattered particles of hæmozoin pigment, though less mature and young ring forms were also seen. The appearances of the parasite identified it as that of tertian fever. The condition entirely subsided under the administration of quinine.

Prior to the War this patient had never been out of Scotland. He was a pottery worker by trade, and had spent most of his life in the vicinity of Paisley. He came to France on May 10, 1915, and landed at Boulogne, from whence he was moved to the Armentières-Bailleul district, and thence after a short time to Lillers, and on to ———, where he remained until the occurrence of his present illness. When not in the trenches he was billeted in various farms; both in billets and in the trenches he suffered a good deal from mosquito bites.

Case 2.—Gunner G., Royal Garrison Artillery, admitted to base

hospital, August 24, 1915. He had been taken ill at the village of ———, near Lestrem. The illness began in the evening, and was of sudden onset with pains in the head and legs, malaise, and shivering, which were, after a time, succeeded by fever and sweating with relief to his symptoms. The following day the attack recurred, and he "reported sick." He was laid up in his bivouac for three days, and finally evacuated as a case of influenza. In hospital he was found to have a marked intermittent fever, the periods of pyrexia recurring every second day, and the temperature reaching on an average 105° to 106° F. The spleen was not palpable. Blood-films, taken during the cold stage of one of the attacks, were found to contain numerous malarial parasites. These, at this time, were chiefly the fully grown and early sporulating forms; in addition typical sporulating forms were seen. The appearances of the parasite and the number of merozoites to which it gave rise enabled it to be identified as that of tertian fever, the *Plasmodium vivax.*

This man, also, had never been out of England prior to joining the Expeditionary Force. He had served four years in the Army and had never seen foreign service. Before enlisting he had been a labourer. He came to France on August 17, 1914, landing at Rouen and subsequently being at Mons and through the retreat. After the battle of the Marne he was in the Ypres district from October to April, when he was moved to the vicinity of Lestrem, where he has been quartered ever since. During the summer he has bivouacked under a temporary tarpaulin shelter in the orchard of a farmhouse; this bivouac was within fifty yards of a canalized river and in a low-lying field surrounded by stagnant dykes, such as are a prominent feature of this part of French Flanders, He was much bitten by mosquitoes.

The significance of these two cases lies in the fact that the possibility of their being recrudescences of an old-standing infection does not occur, so that, in both cases, the infection has taken place in French Flanders, where, so far as I am aware, there is no endemic malaria.

Both these men, then, have contracted the disease in the region occupied by the British Army, and it is logical to conclude that malaria-infected mosquitoes are now present in this area.

The country in which these cases occurred is eminently suited to the mosquito, being flat and well watered. It is largely intersected with deep dykes which, even in the height of summer, have some feet of stagnant water in them and form an excellent breeding-ground. Moreover, the farms of this region are of a very insanitary description and an abundance of decaying organic material is inevitably to be found in their vicinity. Anyone who has lived in this part of France during the summer months can testify to the abundance of mosquitoes, and these are an especial nuisance to the men who commonly bivouac in small tarpaulin shelters of their own construction. In these low shelters mosquitoes and flies of all kinds are extremely abundant and very troublesome.

The country is, then, infested with mosquitoes. Prior to the War there were presumably no malarious inhabitants in this region, but, with the coming of the British Army a certain number of individuals have been introduced with the parasite in their blood and all the factors for the transmission of the disease are thus present. It is a significant fact that the patient in the second of the above-cited cases had, for the whole of the summer, been living in a part of the country which has long been occupied by a division of the Indian troops and where recrudescent cases of malaria are consequently comparatively common.

The occurrence of cases such as those above quoted raises the larger question of the possibility of the disease remaining endemic, and suggests the necessity for the adoption of strictest anti-mosquito measures.

RECEPTION OF WOUNDED WHEN ON ACTIVE SERVICE.

By Major G. BAILLIE.
Royal Army Medical Corps.

Although it may seem somewhat belated to send notes on the subject of reception of wounded, and as each unit has a method of its own which has been found to work well, my excuse for doing so is because the system which has been adopted at this 22nd General Hospital has now been tried for more than three months, and found to work quite smoothly, and in consequence may prove useful to other general hospitals as yet in formation.

There are some important preliminaries to be noted before coming to the actual reception of the wounded in a general hospital.

This general hospital has its wards divided into three sections, viz.: Section "A" (all medical), consisting of eight wards. Section "B" wards 1, 2, 3, 4, surgical; No. 5, dental; No. 6, eye, ear and throat; Nos. 7, 8, 9, medical. Section "C" (all surgical consisting of eleven wards), No. 11 genito-urinary.

The chart on p. 581 is used for the daily return of vacant beds in wards which the medical officers in charge of the medical and surgical sections render daily to the registrar as the wards which they desire to have utilized in the event of a convoy arriving, and for noting the numbers admitted to each ward when the convoy arrives.

The column for "Vacant Beds" is filled in every morning as soon as the wardmasters hand in their lists of beds available in each ward, and later as soon as a convoy is notified each wardmaster places the kits (according to the numbers of vacant beds in each ward) for the patients in the wards which will be assigned to them. This should be done so that the nursing orderlies will not have to do so when the patients arrive, also it may be noted that two extra orderlies are placed on duty at the bath tent to act as conductors for the patients on returning to their

wards, and so release the nursing orderlies who have brought the patients down to the bath tent.

Then one notice of the wards, which will be utilized in event of the arrival of a convoy, is given to the matron, and one is posted up in the officers' mess, it being understood that wards B 5 and 6 may be utilized at any time. If a convoy does not arrive the list of wards to be used holds good until such a time as one does arrive.

The reception tent is a large store tent pitched near the main roadway, with flooring if possible, or if this is not possible the ground is covered with tarpaulin, half a dozen forms for the walking cases to sit on during such time as the stretcher cases are being attended to; there are two large deal tables placed side by side, one for the registrar, and the steward, who enters the diets considered most suitable for each case, and one for two clerks who write down the patients' particulars. Two trestles are placed in front of the registrar's table, about 3½ ft. high, on which the stretcher-bearers place the stretcher while a ward is being assigned and the clerks enter the ward, number, rank, and name, on the index card. On the registrar's right there is a block of wood about 3 ft. long, 1 in. deep, and 4 in. in width, with a number of 3-in. nails driven through, with points upwards corresponding to the numbers of wards in the surgical section, and on each nail according to the number of beds available in each ward there are corresponding numbers of small pieces of paper with the number of the ward written on; one of these pieces of paper is given to each patient as soon as the ward he should go to has been assigned. These pieces of paper must be renewed daily, either owing to an evacuation of patient or the arrival of wounded. In the column "Patients admitted" a straight line is put down to signify a patient who has been injured or ill otherwise than from gunshot wound; a "cross" for gunshot wound (this enables the number of wounded admitted from a convoy to be easily ascertained and wired to the War Office at once), and a small "S" after each admission which has been a stretcher case; this latter precaution is to avoid sending too many serious cases to any one ward; it is also advisable to send about six cases to one ward and the next six to another ward and so on, and then to return to the first ward used, so as to allow the nursing staff time to attend to the cases. A similar board to the one described for the surgical section is also used for the medical section.

Placed in front of the clerks there is a long narrow box divided into sections corresponding to the numbers of the wards, into which the index cards (as soon as the patient's ward has been entered, and his number, name, and rank) are dropped, further particulars being filled in later from the A.F., A 36. Some units use metal discs instead of pieces of paper with the numbers of the wards stencilled on them; this involves a certain amount of trouble in looking after them, and in renewal without any special advantage. Next to the attached chart a similar one is placed

on which the name of the Medical Officer in charge of each ward is typed.

It is useful for the information of the drivers of the ambulances to have a box about 3 ft. long and 2 ft. high, with the number of the particular unit cut out, lined with tin and painted white inside, and placed on a stand about 5 ft. from the ground, and a small acetylene lamp (cost 9 francs) placed inside, and lighted shortly before the convoy is expected to arrive. It should be placed near the entrance of the reception tent and so placed that the drivers will be able to see the numbers distinctly at a considerable distance.

No. of ward	Vacant beds	Patients admitted	No. of ward	Vacant beds	Patients admitted	No. of ward	Vacant beds	Patients admitted
1		SS SS. III XX I I XX	1			1		
2			2			2		
3			3			3		
4			4			4		
5			5	Dental		5		
6			6	Eye Ear Throat		6		
7			7			7		
8			8			8		
9			9					
10								
11	G.u.							

CASE OF SIMULTANEOUS BILATERAL FRACTURE OF PATELLÆ BY MUSCULAR TRACTION.

By Lieutenant J. ANDERSON.
Royal Army Medical Corps.

As this case is unique the following particulars are given :—

Driver J. C. A., aged 31, was admitted to the Connaught Hospital, Aldershot, June 20, 1915, with obvious fracture of both patellæ.

He stated he was practising for regimental sports and that at the time of the accident he was engaged in "hop, step and leap." At the

"hop" he stepped off on his right foot and as he landed he felt the right knee-cap give way. At the moment the left foot touched the ground the left patella also gave. At the time the accident occurred he heard "two cracks," one immediately after the other, and the sound he likened to the breaking of pieces of "dry wood." This occurred before either knee touched the ground.

The soil was soft sand, and there were no stones to fall on as the track had been specially prepared.

He had no pain immediately after the accident, but could not rise from the ground.

The clinical picture was the usual one found in such a condition, with considerable interval between the fragments. There is no family or previous history of bone disease, and patient is a healthy muscular man with large frame.

X-ray examination showed left side simple transverse fracture. Right side, a three-fragment fracture.

Treatment.—Transverse wiring.

Unusual points which justify record :—

(1) Almost simultaneous bilateral fractures by indirect violence.

(2) On one side the fracture was multiple.

Translation.

COMMUNICATION ON THE INTRODUCTION OF A REGULATED AMOUNT OF WINE INTO THE SOLDIER'S RATION.[1]

By M. E. MAUREL.

Correspondant National.

THE Academy has already had three communications on this subject. At the sitting of June 29, 1915, my colleague, M. E. Vidal,[2] has, with his habitual ardour, advocated once more the importance of this step as a preventive of alcoholism; and M. Armand Gautier, who had already broached the subject before the Academy of Science on February 1, 1915,[3] took up the matter again in his masterly manner before our Academy at the sitting of July 6, 1915.[4] But, as he already had done at the Academy of Science, he further has enlarged the question by the

[1] Translated from *Bulletin de l'Académie de Médecine No.* 31, Séance au 3 août, 1915.

[2] La ration du vin aux soldats dans ses rapports avec l'alcoolisme (Séance du 29 juin, 1915, p. 784).

[3] Diététique : sur la ration du soldat en temps de guerre, t. clxix, 1 février, 1915.

[4] Dans la ration actuelle du soldat, il faut diminuer la viande et augmenter les légumes et le vin (Séance du 6 juillet, 1915, p. 5).

addition of some valuable observations on the ration as a whole. The title which he has chosen for his paper sums up very aptly the ideas which inspired him. Finally, at the sitting of July 13, 1915, M. Landouzy[1] taking up this to him familiar question of food allowance and applying it to troops, has demonstrated, *inter alia*, the desirability of replacing a certain amount of meat by wine, and also of varying the ration according to the build (of the soldier).

I am anxious to associate myself entirely with the conclusions of my colleagues. With M. Vidal, and for the same reasons, I agree that the moderate use of wine is a means of diminishing alcoholism, and with M. Gautier, I consider that the soldier's ration is too rich in meat, too deficient in vegetables, and stands to be improved by the addition of wine. Finally, I accept M. Landouzy's views on the variation in ration according to build and in the substitution of wine for a certain quantity of meat.

It is now some time since the rationing of the army,[2] considered broadly, has seemed to me capable of improvement in certain directions —some scientific, others practical.

In 1909 I drew attention to this in dealing with army rationing, and quite recently I returned to the subject before the Scientific and Literary Academy at Toulouse.[3] In this investigation, in addition to some general knowledge acquired on the subject of diet, especially in its relation to physical labour, I have made use of the results of certain experiments carried out by me in the preparation of my essay on "Diet and Sport" and in my investigations regarding expenditure of labour in swimming and cycling.

Perhaps I shall take up this work again for the Academy. For the present I shall limit myself to questions relative to *the introduction of wine into the soldier's ration.*

In 1909, in approaching the question of *table beverages*—wine, cider, perry[4] and beer—I first considered them collectively and discussed the four following questions:—

(1) Are these beverages necessary?

(2) Are they useful—or, more precisely, do they constitute foods?

(3) Are they dangerous?

(4) Under what conditions are they dangerous, and under what conditions may they be safely made use of?

Now, after sifting these questions, I summed up my conclusions as follows:—

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[1] Levin dans la ration du soldat; moyen de lutte contre l'alcoolisme. (*Bulletin de l'Académie de Médicine*, 13 juillet, 1915, p. 53.)

[2] Des troupes des deux armées.

[3] L'Académie des Sciences, Inscriptions et Belles Lettres de Toulouse.

[4] Poiré.

(1) During a meal the addition of some liquid to the solid foods is practically indispensable.

(2) This need not necessarily be a fermented liquor.

(3) Fermented liquors (taken under conditions now known) constitute true heat-energy-producing foods on account of their contained alcohol, and in this respect may be ranked with the starches and fatty foods.

(4) Under certain known conditions alcohol yields the same heat values *in vivo* as in the calorimeter.

(5) Undert he same conditions, during both sleep and muscular work, alcohol replaces sugars and starches practically isodynamically (isodynamiquement).

(6) In these same conditions alcohol may be taken without danger.

(7) The conditions above referred to are as follows :—

(*a*) A maximum daily amount of one gramme per kilometre of body weight (about a quarter of an ounce per stone) should not be exceeded.

(*b*) The alcohol should be taken in a dilution not stronger than 10 per cent.

(*c*) The amount should be divided, not consumed all at one time.

(*d*) It is best taken at meals, not on an empty stomach.

(*e*) If taken between meals, it should be diluted down to 5 per cent or less.

(*f*) As far as possible it should be taken in the form of wine; or at least those liquors which contain the greatest quantity of noxious bodies, *i.e.*, propyl, butyl and amyl alcohol, should be avoided.

Such were the conclusions I came to in 1909 regarding fermented table beverages in general, or, more accurately, as regards their alcohol content. As concerning French wines particularly, I summed up my conclusions as follows :—

It is the alcohol of medium wines[1] which the organism most readily uses up, with heat production equivalent to that of a sugar, to the extent of at least 1 gramme per kilo body weight. Thus for a man of 65 kilos (10 st. 3 lb.) the amount is 65 grammes ($2\frac{1}{4}$ fluid oz.) or about $1\frac{3}{8}$ pints of wine containing 10 per cent of alcohol by volume.

Subsequent workers have confirmed these conclusions, notably Maignon, Batteh and Stern, Debove, Louis Jacquet, M. Nirloux and Placet, Maurice Nirloux, and Ivanov.

This general conclusion, most important and no less reassuring to our populace, has therefore been put beyond the range of doubt, viz.: *That the rich wine products of France, used under conditions fixed by the laws of hygiene, constitute a food of high nutritive value, which is cheap and free from risk.*

This result, important as it is to our general population, is equally

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[1] Vins moyens.

applicable to the army, and it supports the opinions of Messrs. Vidal, A. Gautier, and Landouzy.

In the army the moderate use of wine, as Messrs. Vidal and Landouzy have pointed out, diminishes the risk of alcoholism; moreover, as M. A. Gautier has brought to notice, wine in such proportion has first of all a tonic action, and then constitutes a valuable source of heat and muscular-energy which has, thanks to its facile absorption, the advantage over other elements ternaires of diet of being utilized by the organism very shortly after its ingestion. To these advantages of wine I would add the following :—

(1) *That we find it at our doors.* (2) *That it is cheap.*

(1) As it is a product of France we have it at our immediate disposal and we can exercise surveillance over its manufacture. (2) As far as expense is concerned, its introduction into the soldier's ration (as M. Landouzy has already pointed out) so far from increasing the price, actually enables a substantial economy to be effected. It seems to me important to lay stress on this point.

The State can readily obtain from the wine-growers a wine of 10 per cent alcohol strength at 1s. 1¼d. per gallon[1] or at least at the rate of 1⅓d. per gallon per degree of alcohol. At this price threepennyworth of wine will give 700 calories. Now, if as Messrs. A. Gautier and Landouzy insist *is necessary*, the amount of meat in the soldier's ration is reduced and its place taken by its dynamic equivalent in wine, the State will realize a substantial economy. In eliminating 3½ ounces of boneless meat, giving on average 200 calories, the price of the ration will be lessened by about 2½d. (0 fr. 25). Now wine will give the same number of calories at the cost of about 1d. (0 fr. 10). There will thus be an economy of 1½d. per ration, that is a saving of £12,000[2] a day where two million men have to be rationed.

Further, this substitution of wine for meat especially in campaigning rations is further justified by the following considerations :—

(1) The expenditure of albuminoids by the average man, even under conditions of considerable physical expenditure is not more than 3½ to 4 ounces (100 to 110 grammes), and in the campaigning ration about 5 ounces (140 grammes) of these bodies are present.

(2) The further expenditure due either to radiation from the skin or to muscular work is covered satisfactorily by the constituents of the ration (ternaire).

(3) Wine in the above proportions has the advantage over other constituents of the ration (ternaire) of being assimilable by the organism very shortly after ingestion.

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[1] A 30 francs l'hectolitre, ou du moins du bon vin dont l'alcool serait payé à 3 francs le degré.

[2] 300 mille francs.

Reviews.

MEDICAL HINTS, FOR THE USE OF MEDICAL OFFICERS TEMPORARILY EMPLOYED WITH TROOPS. By Colonel J. E. Squire, R.A.M.C.(V.). London: Henry Frowde, Hodder and Stoughton, 1915. Pp. 128.

Frankly we cannot think that Colonel Squire has been very careful of his reputation in publishing this compilation. The information given is elementary and the work abounds with irregularities and omissions. For instance, in the first part of the article on enteric fever we are told that the pulse is rapid, whilst, when dealing with the differential diagnosis, it is noted as being characteristically slow; nor, unless we are mistaken, do we expect to find a glazed and red tongue in the early stages of this disease, and when Widal's test is referred to, it would have been just as well to point out that inoculation vitiates the result.

In the treatment of amœbic dysentery surely the specific remedy emetine hydrochloride deserves mention, and hepatic abscess should have been mentioned as a complication.

The treatment of cerebro-spinal fever is neither definite nor clear, and a modern text-book should not refer to the injection of serum into the "vertebral column."

The articles on pulmonary diseases, the best in the book, are simple but exhaustive. But we quite fail to see how any person can advocate the retention of soldiers suffering from tubercle of the lung in the service. In dealing with cardiac lesions the most interesting and perplexing condition—disordered action of the heart—is practically ignored.

Prevention of disease, to which the writer makes reference in his preface, finds little space in the book. The standard attained in this primer is below the level of the others published by the same committee, and the book gives little assistance to medical officers doing regimental duty.

CEREBRO-SPINAL FEVER. By T. J. Horder, M.D. London: Henry Frowde, Hodder and Stoughton, 1915. Pp. 179. Price 3s. 6d. net.

If all the treatises on medicine and surgery are as excellent as the one under consideration, then the writers are to be congratulated, indeed, not only upon their foresight, but also upon the success which has attended their efforts. This is the first book in medical literature which deals exclusively with cerebro-spinal fever, and is to be cordially recommended to all medical men.

One needs to be a cavilling critic to find any fault with the book, but there are a few points which could and should be altered in time for the next edition. For example "West's Swab," which is shown in fig. 2 as being half-size, measures only three inches, which is hardly accurate. Again, it is a pity after devoting a whole chapter to the method of "lumbar puncture" to illustrate it by a photograph (fig. 2) showing this operation being performed too low for the space which is so definitely insisted upon. Further, since the author has been at great pains in the first chapter to select the name of "cerebro-spinal fever," it is strange to

find him occasionally referring to it (pages 49 and 86) as "meningococcus meningitis" (why not "meningococcal"?) and on page 76 as "cerebro-spinal meningitis."

The English and style are excellent throughout, although occasionally one stumbles upon long sentences of about seventy words, and such a sentence as the following, without any introduction, appears rather bald:—

Page 105, "VI is, as usual, most frequently involved, then III."

On page 116 the following statement will have to be corrected. In considering the diagnosis of typhoid fever, Major Horder remarks that "a positive blood-culture may *often* be obtained before the agglutination test is available."

If the word "always" be inserted for "often," then it will be more accurate.

The book is written in an extremely easy style, is very thorough, and absolutely complete, and cannot but prove invaluable; and in view of the widely spreading interest which is being evinced at the present time in this disease, its usefulness is apparent.

THE PRACTITIONER'S GUIDE TO CLINICAL RESEARCH. By the Clinical Research Association, Ltd., London. Pp. 149.

This book should prove of the greatest value to practitioners everywhere. The methods for collecting material and sending it to the pathologist are gone into in a most practical way. The clinical significance of the laboratory findings is carefully explained. The sections on the blood and cerebro-spinal fluid are particularly good, but all the sections are well worth careful study.

The book is to be thoroughly recommended.

An appendix at the end explains the cost of examinations of specimens by the Clinical Research Association.

Current Literature.

Lime Salts for Soldiers (from the *Scientific American*, vol. cxiii, No. 17, October 23, 1915).—The remarkable results obtained by the German physiologists, Emmerich and Loew, in their elaborate and extensive experiments with calcium salts as a factor in the diet of both men and animals, have aroused much attention in the past two or three years. The favourable results derived from the use of definite doses of lime salts are ascribed to the fact that calcium is an essential element, if not indeed the most important element which enters into the structure of the cell-nucleus of both animals and plants. This is why such marked debility is found where this element is insufficiently provided. Dr. Loew has recently been continuing his studies of the subject with reference to the use of calcium compounds in the diet of soldiers, whether wounded or well.

In an article contributed by him to the illustrated medical journal, *Hyg* (Munich), he declares that lime is peculiarly valuable in the diet of soldiers in the field, since its presence in the cell-nucleus in sufficient amount increases the organism's power of resistance to the chills and colds that are so often the starting point of serious maladies.

He maintains that lime salts in proper form and quantity work actual miracles. Among the wounded not only were injuries to the bone healed far more rapidly when the diet included a daily addition of 2 to 3 grm. of crystallized calcium chloride ($CaCl_2$), or 3 to 4 grm. of lactate of lime, but such addition usually hastened recovery in cases of other wounds not affecting the bones.

He recommends that at least "calcium bread," which is already much used in Germany, especially in Bavaria or South Germany, should be substituted for ordinary bread in the rations of soldiers engaged in active service.

The manufacture of this bread can be much simplified, it is stated, by the use of the so-called calcifarin flour. This is a compound of calcium chloride with flour, a sort of double compound which does not become damp when exposed to the air. In making the bread it is only necessary to mix five per cent of the "calcifarin" with the flour.

New Device for Treatment of Dislocated and Fractured Lower Limbs (from the *Scientific American*, vol. cxiii, No. 17, October 23, 1915).—A New York surgeon has recently perfected an apparatus designed to treat fractures to the lower limbs as soon as possible after they have occurred. The apparatus is especially intended to meet emergencies and complicated conditions. It may be employed in fractures, gunshot wounds, luxations and dislocations. It may serve as a temporary splint instead of a spica, or again, it may be employed as a permanent splint, depending upon the advisability of recumbent or ambulatory treatment.

The device consists essentially of two flat steel bars attached at their lower ends to a rectangular foot plate. To the external rod are riveted a series of from twelve to fifteen thin aluminium bands which are curved

to fit any lower limb around which they may be placed. The bands are fitted with straps so that they may be tightly held in place. By turning the bands 180° the apparatus may be placed on the other limb. An ingenious foot arrangement enables the patient using such a device to exert a tractive effort to a considerable degree without pain. The entire device weighs but 8 lb.

Briefly, the advantages of the new device may be summarized as follows: The limb is held in absolute immobilization, redression and traction; ambulatory treatment is possible; observation of callus, dressing, drainage, massage and electrical treatment are possible, without removing the splint or lessening the traction; the apparatus is light and compact and can readily be made a part of any ambulance equipment; very little skill is necessary to apply it; practicability in post-operative treatment instead of spicas; and, lastly, it does not interfere with X-ray examinations.

A Study of the Germicidal Action of the Ultra-violet Rays.—E. M. Houghton, M.D., and Lewis Davis, M.S. (Collected papers from the Research Laboratory. Parke, Davis and Co., Detroit, Michigan.)—The authors in their work used a Cooper-Hewitt standard type Y lamp non-immersed type. Liquids were exposed to the rays in a special rectangular trough 15½ cm. by 4 cm. divided into two equal portions by a central septum. After flowing through one side the liquid passed back to the other side by means of a diagonal tube which thus subjected it to a second exposure to the rays.

In most of the work on water the liquid was exposed to the rays in a special bent quartz tube.

(1) Tap water with considerable matter in suspension and having a bacterial content of 800 organisms per c.c. can be sterilized by exposure to ultra-violet rays in a quartz tube at a rate as high as a litre in thirty-eight seconds.

If the rate of flow was reduced to one litre in forty minutes the temperature rose 34° C. giving a final temperature of 60° C.

(2) *Aqueous Suspensions of Bacteria.*—Various aqueous suspensions of *Bacillus coli communis* ranging from 80,000 colonies per c.c. to 750,000 per c.c. were exposed to ultra-violet light at different rates of flow up to a litre in forty-two seconds.

In each case 5 c.c. samples plated out on agar showed no colonies when incubated for three days at 37° C.

B. subtilis with spores was used in a similar series of experiments, 200,000 bacilli per c.c. Complete sterility was obtained even with a rate of flow of one litre in thirty-nine seconds.

(3) *Beef Bouillon.*—It was not found possible to sterilize cultures of *B. coli* in broth even when the rate of flow was as slow as one litre in ten minutes.

(4) *Bismarck Brown.*—Water coloured with Bismarck brown was used; this fluid was infected with *B. coli* and run through at a rate of one litre per minute. Complete sterilization took place showing that the failure of the previous experiment was not due to the colour of the medium but due to the presence of proteins and other bodies of high molecular weight.

(5) *Sodium Chloride.*—Aqueous solutions of common salt in strengths

of 1 per cent, 2 per cent, and 4 per cent, containing as high as 450,000 colonies per c.c. were exposed to the rays. The highest rate of flow was a litre per minute.

In every case 5 c.c. samples of the liquid after exposure failed to show any organisms present. A 4 per cent solution of saccharose was also employed with a like result.

The ultra-violet rays were found to have little or no action on moulds. It was also found that the ultra-violet rays cannot be successfully employed for the sterilization of milk.

To sterilize bacterial vaccines it is necessary to pass the liquid slowly, a flow of about a litre in eight minutes is most satisfactory.

The vaccines must first be shaken to remove clumps. A staphylococcus vaccine of 500,000,000 per c.c. was sterilized in this way.

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Original Communications.

A PRELIMINARY NOTE ON THE TREATMENT OF ABDOMINAL WOUNDS IN WAR.

BY COLONEL CUTHBERT WALLACE.
Consulting Surgeon, B.E.F.

ABDOMINAL wounds only form a small proportion of the injuries met with in war. In nine field ambulances over a period of six months the percentage of abdominal wounds was 1·92. During the same period in seven casualty clearing stations it was 0·72. The smaller figure in the casualty stations is due to better diagnosis and to the heavy mortality in the field ambulances. The mortality in the same field ambulances was 30·33, and in the same casualty stations 56·49. To these mortalities must be added the deaths at the base.

These figures apply to a period when, for the most part, abdominal cases were retained in dug-outs, field ambulances, or casualty stations, and treated by starvation, morphia, rectal saline and rest. Some attempt was made at the casualty clearing stations to treat by operation those cases which arrived in sufficiently good condition, but the result was so bad that operations were for the most part given up. Of late, special arrangements have been made for the rapid transference of abdominal wounds to special casualty clearing stations or special hospitals, and the results justify further efforts.

Various Projectiles causing Intestinal Lesions.

Bullets.—The bullets used in this war inflict injuries which have to be seen to be appreciated. The injuries are described under the different viscera. In the small intestine they seem to reach their maximum destructiveness, but in the colon and stomach they will at times produce complete or nearly complete division of the viscus. The reason of this is supposed to be their rotation in the axis of flight. The multiple injuries in the small gut may have some connexion with a collapsed condition of this tube.

Shell Fragments.—Large pieces will produce extensive injuries as might be supposed, but hardly worse if at all worse than bullets. Small fragments into which the shell may be riven produce injuries like those caused by bombs.

Bombs.—This War has produced much bomb fighting. There are many kinds of these missiles, but they are nearly all reduced by the explosion to small angular fragments. These fragments though small have an immense velocity and therefore a great penetration.

The practical point is that an insignificant wound in the skin may lead down to a series of intestinal perforations. As the whole abdomen may be spluttered over with such wounds, the only way of making sure is to open the abdomen. As many as eighteen perforations in the small gut have been seen. At the same time, they are often few in number and small in size, and are successfully treated by suture.

Dangerous Areas.

The least severe abdominal wound is an antero-posterior one in the epigastrium, and the most dangerous are side-to-side wounds below the umbilicus, antero-posterior wounds in the hypogastrium and wounds in the pelvis inflicted by projectiles that enter from the buttocks or thighs. On the whole, projectiles entering from the back are more fatal than those going in the opposite direction.

The Possibility of the Escape of Viscera in Penetrating Wounds.

It has always been a debated point as to whether a projectile can traverse the peritoneal cavity without wounding a hollow viscus. Since cœliotomy has become the usual treatment this point has definitely been settled and fig. 3 shows a composite chart made of such wounds. This fact is an important one, as it explains the success that has attended the rest and starvation treatment in

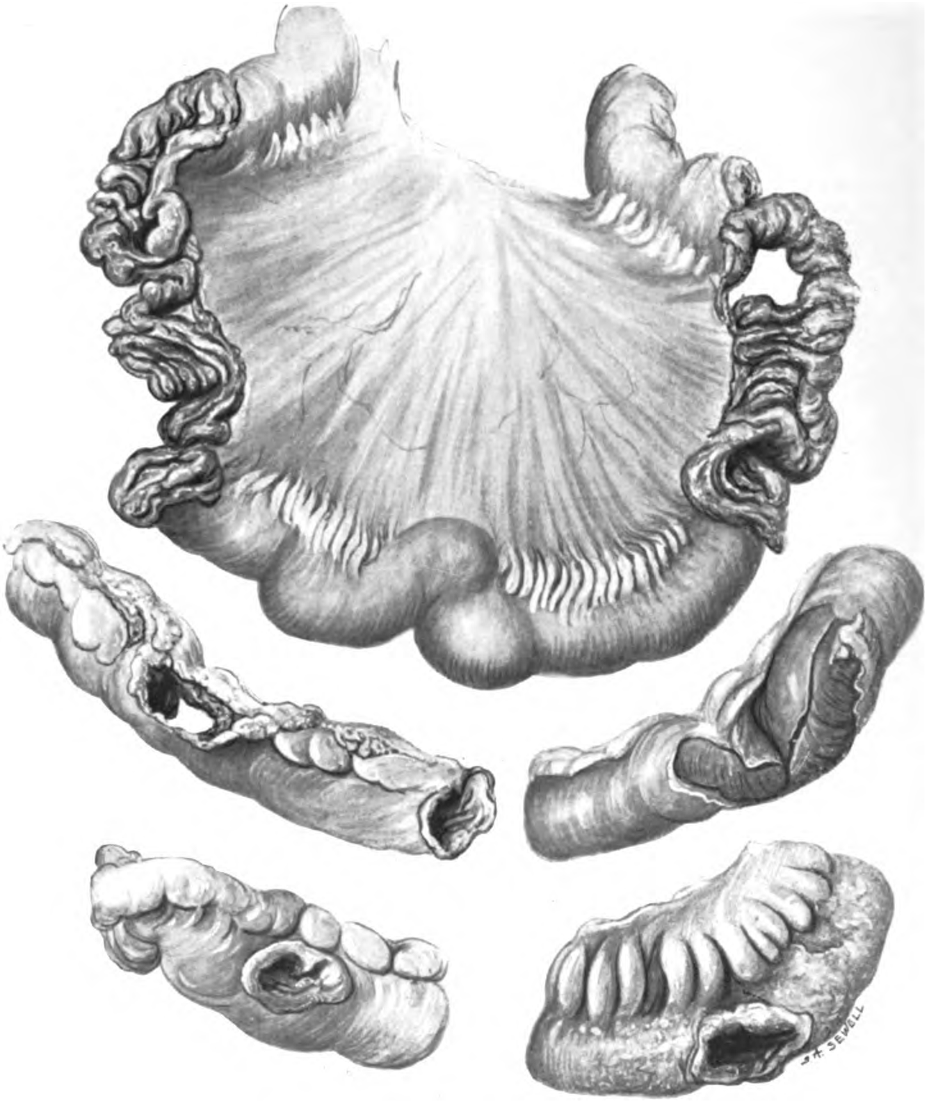

FIG. 1.—Numerous wounds of the small intestine caused by the passage of a single bullet. The two extensive lacerations in the coil of jejunum were separated by about eighteen inches of gut. The remaining openings were in the ileum; one was situated within four inches of the cæcum. The right upper fragment shows an extensive non-perforating lesion of the ileum; the peritoneal coat is widely stripped and destroyed, the muscular coat fissured.

To illustrate "A Preliminary Note on the Treatment of Abdominal Wounds in War," by Colonel CUTHBERT WALLACE.

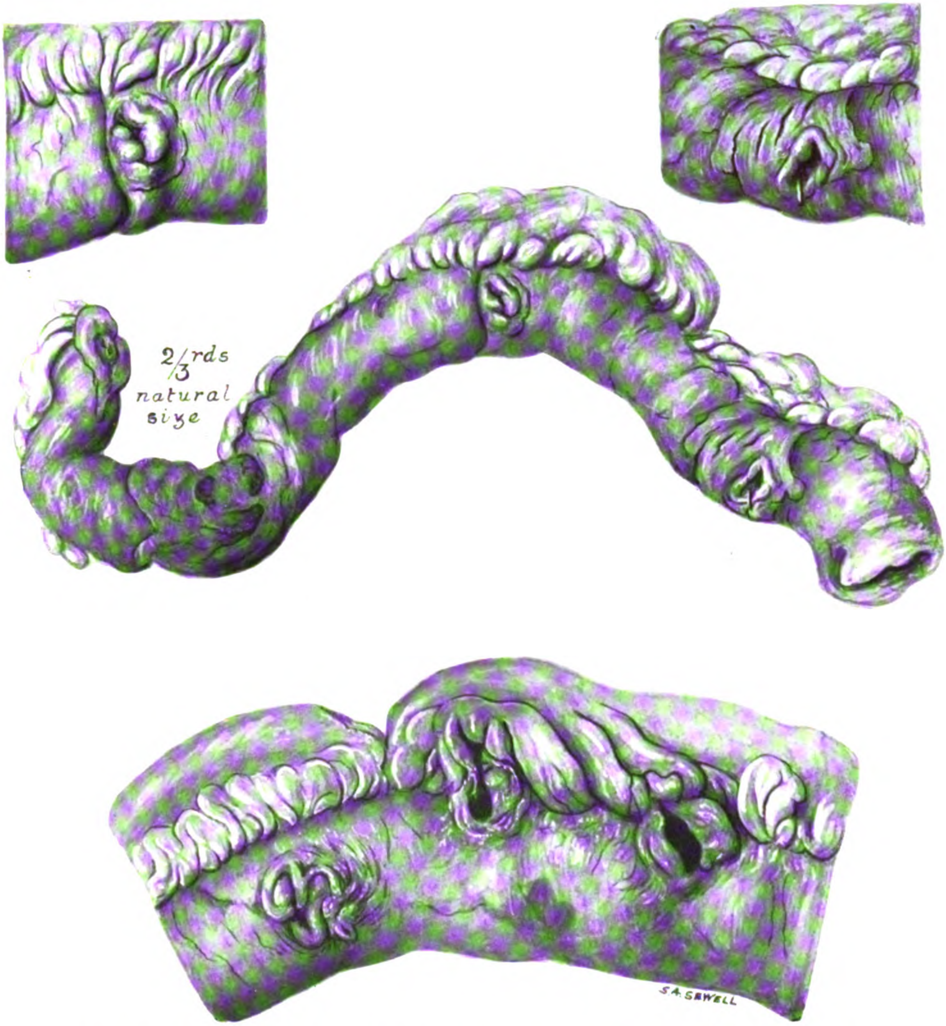

Fig. 2.—A coil of small intestine from a man the subject of multiple bomb wounds. Two gross perforations are shown, differing only in size from those inflicted by bullets. These openings are shown their exact size in the two small inset figures above. The fissuring of the peritoneum around the main opening is well shown in the upper right-hand figure. At the left hand of the coil the intestinal wall has been severely contused; ecchymosis and two non-perforating injuries involving the muscular layer are indicated. Below the posterior aspect of the same coil, drawn to the natural size, exhibits three exit apertures, two of them involving the mesenteric border. The illustration furnishes a good example of the multiple injuries liable to accompany wounds by fragments of bombs.

To illustrate "A Preliminary Note on the Treatment of Abdominal Wounds in War," by Colonel Cuthbert Wallace.

cases where the bullet has traversed the small gut region. There has never been any doubt that the solid viscera could be injured and heal spontaneously.

THE DETERMINATION OF PERITONEAL INVOLVEMENT.

This is done by an examination of the entrance and exit wounds, and as a rule a fair estimate can be made, though even with two wounds it is not always easy.

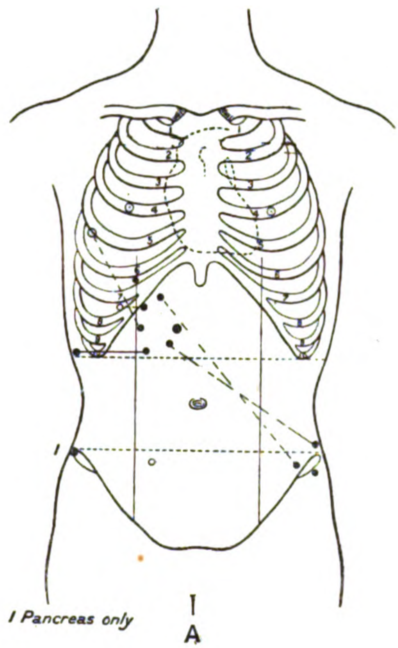

FIG. 3.—Cœliotomy. No wound of hollow viscus.

When there is only one wound the case is much harder, as the direction of the projectile is unknown: One instance may be quoted where a bullet entered near the umbilicus. An incision showed that the bullet had a vertical direction and it was traced down inside the rectus sheath to be lost behind the symphysis. Wounds passing out to the flanks from near the semilunar lines are deceptive, as the thickness of the lateral body muscles is apt to be forgotten.

Wounds in the axillæ are often taken as thoracic, when from the vertical direction of the missile they are both thoracic and abdominal.

In the same way wounds of the buttock and thighs are sometimes penetrating wounds of the pelvis.

Symptoms of peritoneal involvement may be present, but it is not wise to wait for them.

Rigidity of the belly wall and a rise in the pulse are the great guides. These signs are usually present within four to five hours. On the other hand wounds involving the lower chest often give rise to symptoms that are hard to separate from those due to peritoneal involvement.

Causes of Death.—The main causes of death are shock, hæmorrhage, peritonitis and septic infection of the retroperitoneal tissue.

Shock.—This varies to a considerable degree, but is usually present in a fairly marked form. On the other hand a man may have a portion of the belly wall blown away and the viscera exposed without profound or even marked shock. At the same time a few perforations of the intestine may produce so much shock as to make it doubtful if the patient will stand an operation. The determining factors are not very clear.

Hæmorrhage.—This may come from the mesentery, omentum, or retroperitoneal tissue or some solid organ. It is hæmorrhage which is so prejudicial to patients with wounded intestine, and which causes death after a mechanically perfect intestinal suture. Hæmorrhage from the mesentery can be stopped, but the bleeding into the retroperitoneal tissue is often beyond help, as no bleeding point can be found. It is also especially prone to infection.

Peritonitis.—This is the usual cause of death at a late period, as hæmorrhage and shock are at an earlier. In some cases the course is rapid, in others it is of longer duration and causes death in a week or longer period. In rectal wounds the infection is often very virulent.

Infection of the Retroperitoneal Tissue.—Sometimes, as in the case of colon wounds, the source of the infection is the bowel itself. In other cases the infection is caused by the *Bacillus aerogenes capsulatus.* In colon wounds the infection may be extremely rapid or may appear only in the course of a day or two or even later. Gas-forming infections are usually rapidly fatal.

Nature of the Visceral Injuries.

Stomach.—Antero-posterior bullet or shell or shrapnel wounds make small perforations, the latter larger and more ragged than the former. Projectiles passing obliquely across the body make slits in the stomach wall of considerable extent. The stomach mucous

FIGS. 4 and 5.—Anterior and posterior aspects of the stomach with a vertical wound caused by a bullet. The extensive nature of the injury is very striking, and, further, the absence of any eversion of the mucous membrane characteristic in the case of this viscus is well illustrated.

To illustrate "A Preliminary Note on the Treatment of Abdominal Wounds in War," by Colonel CUTHBERT WALLACE.

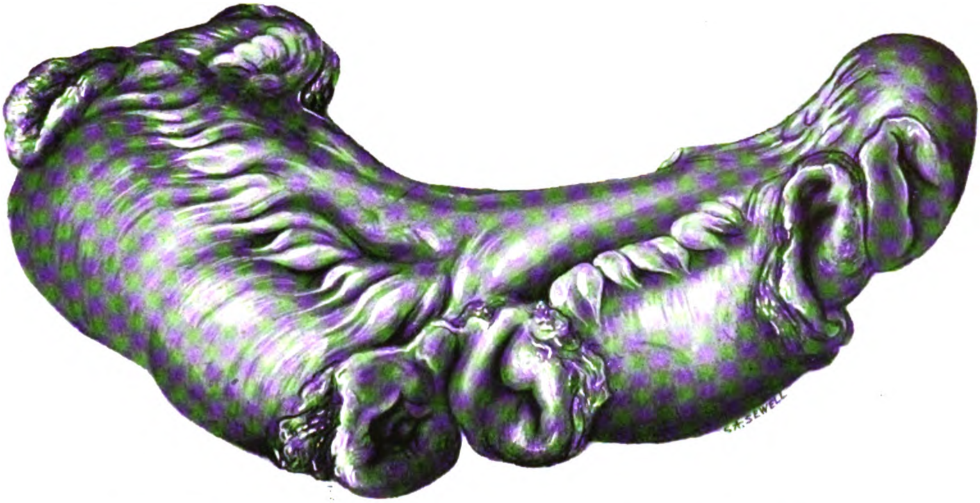

FIG. 6.—Bullet wounds of the small intestine. One complete solution of continuity of the lumen and two perforations are shown. The eversion of the mucous membrane at each is evidence of the recent nature of the injury, and, further, no inflammatory lymph is seen on the surface of the intestine.

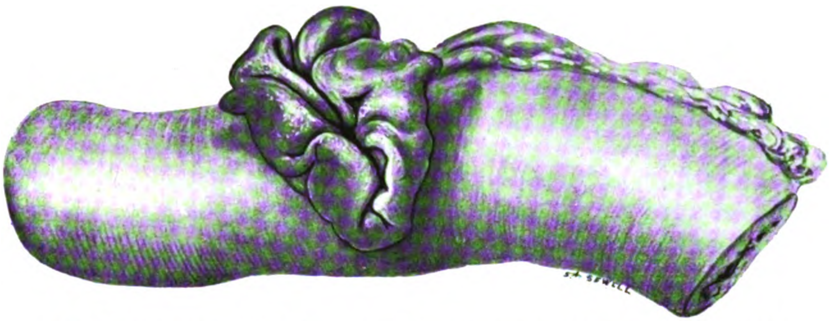

FIG. 7.—Rupture of the jejunum. The great eversion of mucous membrane is well illustrated.

To illustrate "A Preliminary Note on the Treatment of Abdominal Wounds in War," by Colonel CUTHBERT WALLACE.

membrane does not prolapse as does that of the small intestine. The escape of stomach contents depends on the size and position of the wound and the state of the stomach. Small antero-posterior wounds and those near the lesser curvature often show no leakage, while those that are large or linear and near the greater curvature allow of a considerable escape of the organ's contents.

Small Intestine.—The character of these wounds varies with the nature of the projectile, but not to the same extent as would be expected.

A bullet will graze or bruise the gut, make two small or large perforations, divide one half the circumference or completely dissolve the continuity of the intestine. One small hole may be present or many feet of the gut may present all the above types of wound.

The longest portion involved that has come to notice is nine feet.

Usually the injuries are close together, but sometimes two grossly injured portions are separated by a normal length of intestine.

To show what one bullet may accomplish a case may be quoted in which the projectile divided the antral portion of the stomach and the transverse colon, and in addition made numerous perforations in the small intestine.

Colon Wounds.—Intraperitoneal wounds usually are hopeful, especially those of the transverse colon where small uncomplicated wounds are met with.

The wounds of the ascending and descending colon have done fairly well in cases where the intraperitoneal coat is alone torn and to a slight extent. More extensive wounds involving the extraperitoneal coat as well as the intraperitoneal portion are more serious. Suture here is very difficult. Wounds of the flexures are dangerous, especially of the splenic on account of its inaccessibility.

Retroperitoneal wounds caused by projectiles entering from the back are very serious. In the first place there is the difficulty of reaching the wounded part, and next the difficulty of finding the actual hole, and of making sure that the lesion found is the only lesion present. And lastly there is the difficulty of accurate suture.

Wounds of the colon have been overlooked in some cases of cœliotomy, and this oversight has cost the patient his life. The situations of the overlooked wounds were the splenic flexure and the outer part of the vertical colons where the peritoneum passes off the bowel to the abdominal wall.

Escape of Intestinal Contents.—There is usually but little escape

in the case of the small intestine, although the wounds be large; the gut is apparently paralysed. In large gut wounds there may be considerable fæcal outpouring. The non-escape of the intestinal contents is remarkable and fortunate, and as has been said above it is not so much the peritoneal soiling that is responsible for the fatal cases as the slow progressive loss of blood.

Liver.—Many liver wounds require no surgical interference. If a chart of such abdominal wounds as are sent to the base without operation is made it will be found that the greater part of those wounds are in the right hypochondrium or right epigastrium. The actual lesions of the organ are very varied. There may be a scratch or deeper score of the surface, a deep ragged wound, a complete perforation, sometimes a narrow track, sometimes a ragged cavity. In some cases the liver is almost torn in two and at other times almost pulped. Shell fragments are responsible for most of the bad wounds, but a bullet will also produce almost complete disruption.

The common duct and cystic duct have both been found torn. The hæmorrhage is in some cases quickly fatal, in others slower but continuous. Jaundice is not very unfrequently seen and a biliary peritonitis has been met with on several occasions.

Kidney.—There are no special points to notice except that operation is rarely required. Sometimes the organ requires removal on account of hæmorrhage.

Spleen.—This organ is often wounded with the kidney and instances of successful packing and removal have occurred. Wounds are often complicated by those of the stomach and splenic flexure.

Pancreas. — This organ is generally wounded by projectiles passing from side to side or entering from the back. The wounds are usually found in the course of an exploratory cœliotomy and complicate other injuries. Fat necrosis has been remarked in three cases. Injuries of the pancreas are very fatal.

Bladder.—Injuries are not so frequent as would be expected. They generally do well if treated by a suprapubic cystostomy.

Question of Operation in Abdominal Injuries.

It is only recently that abdominal wounds have been systematically treated by immediate operation. The reason for this has been twofold. In the first place there was the belief that abdominal penetrating wounds were best treated by immediate rest and by the withholding of food and fluids by the mouth. This was a legacy left us by the South African War.

Fig. 8.—Small perforating wound of the anterior aspect of the cæcum, accompanied by bruising of the external aspect. The cæcum is already clothed with a thick layer of inflammatory lymph, extending on to, and fixing, the termination of the ileum. The intestine beyond shows little change.

To illustrate "A Preliminary Note on the Treatment of Abdominal Wounds in War," by Colonel Cuthbert Wallace.

FIG. 9.—Practically complete division of the transverse colon.

To illustrate "A Preliminary Note on the Treatment of Abdominal Wounds in War," by Colonel CUTHBERT WALLACE.

In the second place the results obtained in the early part of the war were disappointing to the operators. It was not appreciated that the mortality must be very heavy from the nature of the injury.

The "rest" treatment was based on the belief that penetrating wounds of the intestine would heal by themselves. It was pointed out that many cases who were undoubtedly shot through the abdomen did recover, and it was assumed from the direction of the missile that the intestine must have been injured.

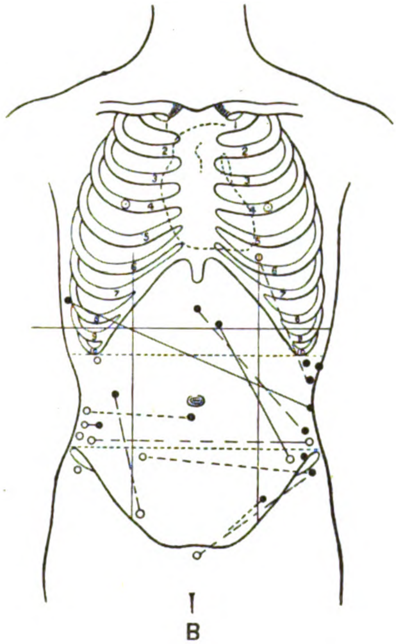

FIG. 10.—Cœliotomy. No wound of any viscus.

Recent operations (see fig. 3 and fig. 10) have proved that the abdomen can be traversed in many directions and yet the intestines escape injury.

It has also been proved by operation that many wounds that apparently pass through the cavity of the peritoneum only penetrate the abdominal wall.

The presence of the signs of peritonitis in patients who eventually recover has been pointed out as a sign that wounded hollow viscera heal without surgical aid. In answer to this it can be said that blood and bile will produce these symptoms.

Again, a large series of operations proves that the injuries of hollow viscera are rarely single or simple, and that more commonly there are multiple perforations, and often multiple complete divisions of the gut, also that a bullet may produce as great injuries as shell fragments. No one who has seen these injuries believes that spontaneous cure could be anything but very rare.

It can be definitely stated that the old belief in the spontaneous cure of gut wound is fallacious and dangerous. The stomach is the only hollow viscus in which spontaneous recovery may take place.

Everybody knows that if intestinal wounds are to be treated by operation, the operation must be done early. In the early stages it is not possible to definitely diagnose an intestinal lesion. Some cœliotomies will only reveal intraperitoneal bleeding. In some cases the bleeding, as in the case of wounded mesentery or omentum, will be actually assisted by means of the operation. In others no bleeding point will be found. It only remains to determine whether the mortality in such cases balances the improvement in the mortality of the cases with injured intestine. The answer is that it does not by any means.

Treatment of Visceral Injuries.

It is not the object of this paper to discuss at length the actual treatment of the injuries, but a few cases may be of interest.

Stomach.—Some surgeons who are persuaded that cœliotomy in abdominal wounds below the transpyloric plane is the best routine treatment, are still inclined to leave epigastric or hypochondriac injuries alone. I am not of this opinion and believe that on the whole the patient has the best chance if the abdomen is opened and the lesion sutured. As has been said above, many wounds of the stomach are of considerable extent and allow of the escape of the gastric contents. Again, wounds of the lesser curvature are very apt to gape, and in the recumbent position will allow the contents to escape.

Stomach wounds are easily found and easily sutured, the only ones likely to give trouble are those of the cardiac end, and which are caused by projectiles coming in from the axilla. Here too the spleen or splenic flexure are likely to be wounded. Perforations on the posterior surface are reached through the gastro-colic omentum.

Small Intestine.—Suture should always be tried, even if it causes some narrowing of the intestine. As the rents are usually at right

angles to the long axis of the bowel closure can often be made without contracting the lumen too much. With more severe injuries resection must be undertaken. Circular enterorraphy has been successful and is much quicker than lateral anastomosis. As much as 9 feet have been successfully resected, but 6 to 18 inches is perhaps the usual length of gut requiring removal.

Colon.—Intraperitoneal wounds may be sutured, but if the rents are large a colostomy, especially in the vertical colons and flexures, is the safest course. Retroperitoneal wounds are best treated by the establishment of an artificial anus, a free opening being left at the sides to drain the infected areolar tissue.

Cæcum. — Suture of the cæcum has been successful, but cæcostomy is sometimes necessary where muscle tissue has been lost.

Rectum.—It is difficult to say what is the best treatment as experience has not been large owing to the rapid infection of the peritoneum producing a condition in which operation is impossible. Suture and a transverse colostomy is possibly the best course.

The Results gained by early Operation.

The early operative treatment of abdominal cases has been in practice too short a time for the production of accurate figures, but it can be said that there has been a considerable reduction in the mortality. This will be always more marked in quiet times when the transit of these cases can easily be arranged. When large military operations are in progress it is not possible to give such individual attention, but even here there has been improvement.

The mortality in six casualty clearing stations from July 1 to September 25 of this year was 48·77. This shows an improvement on the mortality of 56·49 quoted above, although that was for a mixed period of quiet and fighting. Since July 1 accurate records have been kept of all abdominal cases, and only those that were truly penetrating have been included.

Conclusion.

The mortality of abdominal wounds must always be very heavy, but the results obtained by operative treatment are most encouraging. No one who had the opportunity during the last few months of operating on such cases has any doubts as to the success to be gained by this method.

OBSERVATIONS ON THE COMMON INTESTINAL PROTOZOA OF MAN: THEIR DIAGNOSIS AND PATHOGENICITY.[1]

By C. M. WENYON, M.B., B.S., B.Sc.Lond.
Director of Research in the Tropics to the Wellcome Bureau of Scientific Research.

(*With Plates.*)

At the present time, while there is a great influx of individuals into this country who have been residing for a longer or shorter period in tropical or sub-tropical countries, certain types of infection, which usually only come to the notice of those interested especially in tropical medicine, are likely to be encountered by many who have not had any previous opportunity of studying the organisms present. Having had during a period of ten years as protozoologist to the London School of Tropical Medicine abundant opportunity of studying the protozoal infections of man both in this country at the Albert Dock Hospital attached to the Tropical School and in many parts of the world abroad, I have thought it useful to give a short account of one group of protozoal organisms which infect human beings, especially in warm climates. I refer to those protozoa which inhabit the digestive tract, some of which are definitely pathogenic and invade the tissues, others which are less certainly injurious, and, finally, some against which it is difficult to produce any evidence of harmful action whatever.

The protozoa which are to be found in the intestine belong to three[2] of the great subdivisions into which these organisms are grouped. Belonging to the Rhizopoda we have the definitely pathogenic *Entamœba histolytica*, the quite harmless *E. coli*, and a small amœboid organism which on account of its resemblance to the free-living water amœba, *Amœba limax*, is often considered to be actually this amœba or one nearly related to it which has taken up a temporary existence in the human intestine. All these inhabit the large intestine and cæcum.

To the group of the Mastigophora belong three flagellates which are commonly to be found in the human intestine—*Trichomonas*

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[1] Reprinted from the *Lancet*, November 27, 1915, with a new Appendix.

[2] Quite recently a Coccidium belonging to the group Sporozoa has been found in the cases from Gallipoli (see *Coccidiosis* at end of paper), so that members of all four subdivisions of the Protozoa are to be found in the human intestine.

intestinalis, *Tetramitus mesnili*, and *Lamblia intestinalis*. Of these *L. intestinalis*, inhabiting the upper part of the small intestine, has the greatest claim to being pathogenic; *T. mesnili* has been supposed to give rise to intestinal irritation followed by diarrhœa, while *T. intestinalis* is generally regarded as quite harmless, though Escomel in South America claims to have cultivated this organism and to have produced diarrhœa in dogs by injection of these cultures. The two latter flagellates inhabit chiefly the large intestine and cæcum, and are to be found in greatest number when the intestine is deranged for some reason or another, for the change in the intestinal contents resulting from such diseases as typhoid, dysentery, etc., seems to induce a very active multiplication of these organisms. There are other flagellates which are much less frequently met with. These are species of *Bodo*, *Cercomonas*, and *Prowazekia*, simple organisms, each with two flagella, which occur especially in diarrhœic conditions and which are possibly only free-living flagellates which have found a suitable medium of development in the altered condition of the gut. Several members of the group Ciliata have been described, but only one of these has any claim to being a common parasite. This one is *Balantidium coli*, a large organism which lives in the large intestine. Pigs are generally infected with this ciliate, which, escaping from them in the encysted condition, gains entrance to the human intestine, and by actual invasion of the wall of the large intestine produces the serious condition known as balantidial dysentery.

In this paper I wish to give a short account of these various protozoa, more especially from the point of view of diagnosis and the methods I have found useful for their identification. That such identification is important goes without saying, for on it may depend the actual treatment of any individual case.

Some years ago I read a paper before the British Medical Association on the subject of the intestinal entamœbæ of man and their differentiation. I showed there that the pathogenic *E. histolytica* was most readily distinguished from the harmless *E. coli* by the examination of the encysted forms—forms which have protected themselves by the secretion of resistant transparent capsules which will enable them to withstand exposure after their escape from the human intestine and until they can succeed in gaining entrance to another individual. Now with all the intestinal protozoa of man, with the possible exception of *T. intestinalis*, infection spreads from one individual to another by means of encysted forms which,

as far as we know, undergo no development outside the body, but simply lie about in water till they are ingested by another individual. If by any chance an unencysted protozoon should escape from the intestine, and this happens very commonly when infected individuals have attacks of diarrhœa which flush out the intestine, such forms invariably die quickly, and it is difficult to see how they can be responsible for the spread of infection. In the case of *T. intestinalis*, however, encysted forms have not been definitely described, and it is perhaps owing to this that *T. intestinalis* survives in fæces it may be a week or more after escape from the body in the unencysted condition. With this possible exception, in the normal course of events it is only the encysted forms of these protozoa which escape in the fæces and are destined for future development in another human host. Manifestly, then, it is important to be able to recognize not only the free-living forms of the intestinal protozoa as they move about in the intestine, but also the encysted forms which, corresponding to the eggs of worms, may in the same way be the only indications that there is an infection of the intestine with any particular organism. The finding of the eggs of *Ankylostoma duodenale* or of *Ascaris lumbricoides* in the fæces of an individual shows that the intestine is harbouring these worms, and similarly the discovery in the fæces of the encysted forms of *E. histolytica* or *L. intestinalis* shows that an infection with these protozoa exists and, in the case of the former at any rate, calls for energetic treatment, for such an infection may be the cause of the spread of amœbic dysentery to other individuals, or may be followed by a fatal attack of dysentery in the person himself.

Naturally enough, the intestinal protozoa are usually encountered when there is some definite intestinal derangement, for it is only in such conditions that the fæces are submitted to examination. The finding of these comparatively large and active organisms, sometimes in enormous numbers, is likely to lead to the conclusion that they must be the determining factor of any intestinal symptoms which may be present. The findings can only be controlled by the examination of normal individuals. In tropical countries frequently over fifty per cent of the normal population harbour *E. coli*, and Schaudinn showed some years ago that in certain parts of Germany a still larger percentage were infected. Similarly, in tropical countries flagellate infections of the intestine are exceedingly common apart from symptoms, so that when they are met with in cases of diarrhœa one must very carefully exclude all other causes,

bacterial or irritant, before concluding that flagellates have produced the condition in question. In the case of *E. histolytica* and *B. coli* there are produced by these protozoa extensive lesions of the bowel, in the tissues of which they may be found. They wander far afield and produce lesions in the mesenteric glands, liver, and other organs, while, experimentally, animals may be infected and in them are produced lesions similar to those in man. In these cases it is impossible to doubt the pathogenicity of the protozoa. In the case of the flagellate infections, however, no definite lesions of the gut occur, and as no satisfactory post-mortem material can be obtained owing to the rapid degeneration of the protozoa after the death of the host it is very difficult to obtain any definite proof of pathogenicity. Experimental infections in animals have not given very satisfactory results, and no one has yet been able to obtain pure cultures of these flagellates. The subject is a difficult one and requires further investigation before we can definitely assert that the intestinal flagellates are pathogenic.

Another point which must be borne in mind is that the intestinal flagellates, in common with intestinal bacteria, sometimes invade the tissues shortly before or after death. This is due apparently to a diminished resistance on the part of the intestine, which permits the passage of organisms which normally only live in the lumen of the gut. Cases of this invasion are fairly common in animals. Gonder, for instance, found *Lamblia* in the blood-stream of a fowl, and quite recently Basile in Italy has noted a case of *Lamblia* of the liver of a rat, which was dotted over with white cysts containing a fluid in which the flagellates were living. Basile inoculated a rat with some of this fluid intraperitoneally and later discovered *Lamblia* in the liver and mesenteric glands. These are exceptional cases, but so long as they occur there is the possibility that the invading flagellates will give rise to symptoms of one kind or another.

I will now give a description of the various protozoa mentioned above, the method of their detection, and what is known of their habits and pathogenicity.

Entamœba coli (figs. 27 to 32).

This amœba was first satisfactorily described by Casagrandi and Barbagallo, and it is perhaps the commonest protozoon of the human intestine. It seems to be a perfectly harmless organism, and in many parts of the world more than half the healthy population are infected. It inhabits the large intestine and cæcum, where

it crawls about by its amœboid movements amongst the intestinal contents and more especially over the surface of the gut. It consists of a mass of cytoplasm which varies in diameter from ten to thirty microns, though larger or smaller forms may occur. It has a single large spherical nucleus consisting of a nuclear membrane on the surface of which are irregular masses of chromatin which appear as greenish refractile granules in the living condition. At the centre of the nucleus a granule, the karyosome, can be seen. The cytoplasm is often very much vacuolated, the vacuoles containing bacteria, yeasts, and even encysted and unencysted flagellates, which the amœba has ingested. It is most vacuolated and granular towards the centre and becomes less so towards the periphery, but there is, as a rule, no sharp distinction between ectoplasm and endoplasm. The whole organism tends to have a greyish colour, is of liquid consistency and not highly refractile. When it moves it throws out pseudopodia, which are blunt structures, and in these again no clear line of demarcation can be made out between ectoplasm and endoplasm, unless at the very commencement of pseudopodium formation. The nucleus can usually be seen clearly in the living condition unless it is obscured by vacuoles and their contents, and it changes its position in the cytoplasm with the movements of the amœba. The amœba even when observed in the warm stage moves very slowly, so that occasionally the only sign of life is a gradual change in shape.

Reproduction is by simple division. The single nucleus divides, and this is followed by division of the cytoplasmic body. The two amœbæ thus formed increase in size and later divide again. In this way the infection of the large intestine is maintained. The size of the amœbæ depends largely on the rate of multiplication, for if the divisions succeed one another rapidly before there has been time for growth to the original size then the amœbæ tend to decrease in size, and conversely when division is slow they tend to be large.

As reproduction is proceeding in the large intestine certain individuals cease to multiply; they discharge all their food contents and, becoming spherical, secrete round themselves a protective covering or cyst. This is a transparent capsule very much like, but not so thick as, the shell of an ankylostome egg. When encystment has taken place a passive body is produced, which is carried down the intestine and eventually is discharged in the fæces. During the passage down the large intestine the single nucleus possessed by the encysting amœbæ divides into two, each of these divides

again to produce four, and the four again to produce eight (fig. 31). Cysts may be discharged in any of these stages of development, but most usually it is the fully developed cyst containing the single mass of cytoplasm in which are embedded eight nuclei which is met with in the fæces. The size of the cyst of *E. coli* varies between 15 and 20 microns, though slightly larger and very exceptionally smaller ones occur. After escape from the body they undergo no change till they enter a new host, probably in drinking water. Under the action of the digestive juices, according to the investigations of Casagrandi and Barbagallo, the contents of the cyst divide into eight small amœbæ, which escape into the intestine by rupture of the cyst. The fate of these small amœbæ has not been definitely traced, though it is suggested that they are in reality gametes or sexual forms which conjugate in pairs to form four amœbæ, which proceed to grow into the ordinary adult forms of *E. coli*. Schaudinn described a complicated sexual process (autogamy) as taking place in the cyst, but so far this has not received confirmation.

Infection of the intestine with *E. coli* is most readily recognized by the detection of the very characteristic encysted forms. The amœbæ themselves often occur in the fæces, but their differentiation, especially for the uninitiated, from *E. histolytica* may be a matter of great difficulty. The cysts, however, are easily recognized as clear refractile spherical bodies of very sharp outline which are readily seen with a $\frac{1}{6}$ or $\frac{1}{8}$ objective. In searching for them, and indeed for all intestinal Protozoa, it is essential to use only small quantities of material well diluted with water, or preferably saline and covered with a cover-glass. It is also necessary to be careful that the cover-glass is not floating about on the slide, for this will prevent satisfactory examination with the $\frac{1}{12}$ oil immersion. A rather dull light must be used, and I have found that the details can be more readily detected by reducing the light by lowering the condenser rather than by shutting out the light by means of the diaphragm. Under such conditions with $\frac{1}{6}$ objective it may be possible to detect within the cyst the characteristic eight nuclei. They appear as very faint greyish granular rings with a central dot or karyosome, and as the cyst is spherical they are not all in focus at the same time; to see them all one must focus up and down to bring different planes into view. The nuclei, however, are best seen by using the $\frac{1}{12}$ inch oil immersion lens and a No. 2 eyepiece. Here, again, it is generally necessary to reduce the light by lowering the condenser slightly. It is very important to see the nuclei properly, for on them depends

the absolute diagnosis of the cyst. They do not stand out in very great contrast to the cytoplasm within the cyst, but when once seen they are found to be quite sharply defined structures. They may be much more easily seen in one cyst than in another. The nuclei may be more clearly seen after the addition of a little iodine solution, as explained at the end of the paper. It is also important to determine the size of the cyst.

Occasionally abnormal forms occur. The commonest abnormality is the presence in the cytoplasm within the cyst of a large vacuole, which has the effect of pushing the nucleus to the side (fig. 32). It apparently hinders nuclear division to such an extent that these cysts frequently contain only two and rarely four nuclei. Another irregularity which I have very rarely seen are cysts in which there are sixteen instead of eight nuclei, while occasionally one meets with chromidial bodies like those so commonly seen in cysts of *E. histolytica*.

An individual infected with *E. coli* may retain the infection for years, as I have observed in some cases, and this in spite of treatment with intestinal disinfectants or treatment with emetine, which has such a marked effect in destroying the pathogenic *E. histolytica*. It is, perhaps, worthy of note that amœbæ closely resembling, if not identical with, *E. coli* have been found in rats, mice, monkeys, and other animals.

Entamœba histolytica (figs. 33-40).

Of all intestinal protozoa of man this one is the most dangerous in being the cause of amœbic dysentery and liver abscess. The dangers, however, are now largely reduced owing to the reintroduction by Rogers of emetine in the treatment of these diseases.[1] This drug appears to be a specific and has a most remarkable action upon *E. histolytica*, which disappears rapidly from the intestine when it is administered. This organism is undoubtedly the one studied and described by Lösch in Petrograd in 1873-4 under the name of *Amœba coli*, a name which later was employed for the non-pathogenic species.

E. histolytica differs little in size from *E. coli*, and, like it, is primarily an inhabitant of the large intestine. It has, however, the power of invading the tissues and multiplying in distant organs like the liver if it is carried there in the blood-stream. There are two distinct types of this amœba—one of the tissue-invading form

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[1] *Lancet*, October 19, 1912, p. 1062.

known as the *tetragena* form, and the other a smaller form known as the *minuta* form, which lives, like *E. coli*, on the surface of the mucous membrane. The former is the one which is found in acute amœbic dysentery, when the stool may consist of little more than blood and slime. As the acute symptoms abate and the stools return to the normal the tissue-invading forms become replaced largely by smaller amœbæ, which appear to maintain the infection of the gut while tissue-invasion is in abeyance. They can often be found in numbers in stools which are quite or almost normal, though individuals thus infected are liable to repeated mild attacks of diarrhœa in which small quantities of blood and mucus are found, and they may at any time relapse into the acute dysenteric condition when the large tissue-invading forms reappear in the fæces. During the height of a dysenteric attack the only forms to be found in the fæces are the large tissue-invading forms about 15 to 30 microns in diameter (figs. 33 and 38). They are much more refractile and greenish-looking than *E. coli*; the spherical nucleus is smaller and has upon its membrane much finer granules of chromatin than that of *E. coli*, and on this account the nucleus is more difficult to detect in the living amœba. There is, further, a very clear distinction between ectoplasm and endoplasm, and when pseudopodia are formed they are found to consist entirely of highly refractile ectoplasm. The endoplasm may be vacuolated, but contains red blood corpuscles and leucocytes rather than bacteria, yeasts, and other foreign bodies. The presence of red blood corpuscles is a great aid to diagnosis, for *E. coli* does not ingest them. The movements of this amœba resemble, but are much more active than, those of *E. coli*. The tissue-invading forms multiply by simple division but do not encyst, in consequence of which encysted forms of this amœba are not found during a dysenteric attack. It might be difficult, therefore, to distinguish this amœba from *E. coli*, but for all practical purposes, if there are definite symptoms of dysentery with blood and mucus in the stool and large active amœbæ occur especially in the mucus, and some of them are found to contain red-blood corpuscles, it can be assumed that the case is one of amœbic dysentery due to *E. histolytica*. *E. coli* might conceivably occur under such conditions, but experience has shown me that this is practically never the case.

The greatest difficulty in diagnosis occurs when the acute symptoms have abated and the stools have almost returned to the normal. As already explained, under these conditions the large forms of the amœba are becoming replaced by smaller ones, which

vary in size from 10 to 20 microns (figs. 39 and 40). Unfortunately they often resemble *E. coli* closely, so that a diagnosis may be impossible if one had only the amœbæ to go by. Luckily, however, it is at this stage that cyst formation takes place, and while the infection is maintained by the multiplication of these smaller amœbæ by simple division, as in the case of *E. coli*, certain individuals become encysted (figs. 34 to 37). The cysts escape from the intestine, and they have characters which enable them to be recognized fairly readily. They are spherical, but not so accurately spherical as the cysts of *E. coli*. They are smaller, having a diameter of 10 to 14 microns, and in accordance with the higher refractiveness of *E. histolytica* the cysts are more refractile, so that the contents are more difficult to see clearly. Nuclear multiplication leads to the production of two and then four nuclei, and only very rarely indeed eight. In the case of *E. coli* the cysts which escape have nearly all reached the eight-nuclear stage, whereas with the cysts of *E. histolytica* it is very usual to find the cysts voided in all stages of development. The fully-formed cyst of *E. histolytica* is then a spherical greenish refractile body 10 to 14 microns in diameter enclosing a single mass of cytoplasm containing four nuclei, which often lie in pairs at opposite poles of the cyst. Fairly frequently the cysts contain in addition to the nuclei one or two or more rods of a homogeneous highly refractile substance, which go by the name of the chromidial bodies, and, further, there may be a large vacuole in the cytoplasm. If only a single cyst is seen it may be difficult to diagnose with certainty, but a single fresh cover-glass preparation will often contain fifty or more, so that a definite opinion can easily be arrived at.

As in the case of *E. coli* the cysts are responsible for the spread of infection, so that an individual who has recovered from an attack of dysentery, but who is still harbouring the small amœbæ which are producing the cysts, is a carrier who is far more dangerous to the general public than an individual who is actually suffering from true amœbic dysentery. Apparently carriers may maintain their infections for long periods, during which time they are constantly passing cysts, sometimes in enormous numbers, and certainly spreading the infection in this manner. In a place like Gallipoli such infective cysts may be spread by any agent which will distribute them such as flies, water, wind, and possibly also dust. Fortunately a simple microscopic examination of the fæces, as explained above, will detect the condition, and a treatment by emetine injections will almost certainly get rid of it. On several occasions I have produced

typical and fatal amœbic dysentery in cats by administering fæces obtained from such carriers of infection, who have shown at the time no signs of amœbic dysentery.

Amœba limax (*Wahlkampfia limax*) (figs. 45 to 47).

In addition to the two common amœbæ described above there occurs sometimes in the large intestine of man a small amœba about ten microns in diameter. It resembles very closely free-living water amœbæ of the *Amœba limax* type, and it may be one of these present in the gut accidentally. Encysted forms of free-living amœbæ, which are almost as widely distributed as bacteria, are being constantly eaten with food, and it is supposed that under certain conditions not at present understood the amœbæ escape from the cysts in the large intestine and there multiply. As a rule, however, the cysts pass unchanged through the intestine. These amœbæ are recognized from the true entamœbæ by their small size and the character of the nucleus, which is a spherical body enclosing a very large central karyosome. Many attempts have been made to obtain cultures of *E. coli* and *E. histolytica* by inoculating various media with fæces containing them, and in certain cases cultures of amœbæ have been obtained, but the amœbæ in the cultures always have the characters of the small *limax* amœbæ and not those of the entamœbæ. It is probable that the cultures obtained, as I pointed out so long ago as 1907, and as has recently been conclusively demonstrated by Walker in the Philippines, have originated, not as supposed from the entamœbæ, but from the small *limax* amœbæ or their cysts, which have been undetected and accidentally present in the inoculated material.

In the large intestine these small *limax* amœbæ have no pathogenic significance and are recognized from the entamœbæ chiefly by their small size. They are, however, difficult to distinguish from certain intestinal flagellates which have become rounded and changed after having left the body for some hours, and furthermore it seems certain that flagellates belonging to the genera *Cercomonas*, *Bodo*, and *Prowazekia* have an amœboid stage which is indistinguishable from a typical *Amœba limax*.

Trichomonas intestinalis (figs. 20 to 26).

Of all the intestinal flagellates of man this is by far the commonest. It lives in the large intestine and cæcum, where it occurs sometimes in enormous numbers and varies very considerably in size. It has a pear-shaped body varying in length from

about 5 to 15 microns. At the blunt anterior end of the body is a spherical nucleus, just anterior to which is a chromatin granule from which arise three long free flagella which are directed forwards, and a fourth thicker flagellum which passes backwards in a slightly spiral manner attached to the border of an undulating membrane, beyond which it is continued at the posterior end of the animal as a free flagellum. Near the nucleus at the anterior end is a slight conical depression, the cytostome. Running along the base of the undulating membrane and arising from the granule from which the flagella spring is a stiff rod which may function as a stiffening rib for the membrane. Another structure, the axostyle, arises near the cytostome in the nuclear region. It is a clear refractile bar, which is continued through the body towards the posterior end, where it protrudes through the surface as a sharp point. The cytoplasm of the body is often vacuolated, and within the vacuoles are bacteria which appear to be ingested as food.

In the fresh condition the flagellates progress rapidly by vigorous lashing movements of the three anterior flagella, while the undulations of the membrane and the movements of the attached flagellum cause it to revolve on its longitudinal axis. The movements may be so rapid that the study of the organism is difficult. After some time the movements slow down, and then with the one-sixth or one-eighth inch objective the characters can be easily seen. Often when a preparation has been first made no flagellates are visible, but after a while they are seen to wriggle out of the thicker portions into the more open parts or streams of liquid, in which they swim about very rapidly. As they revolve the undulating membrane becomes visible when it is directed upwards. Even then some difficulty may be experienced in seeing clearly the anterior flagella, which are very fine structures. This difficulty can easily be remedied by examination with the dark-ground condenser, for then not only are the flagella clearly visible, but all the movements of the flagellate are beautifully seen. It is important to count the three anterior flagella, for it is only by this means that one can distinguish the *Trichomonas* from two other closely allied though much rarer forms—the *Tetratrichomonas*, which only differs in the possession of four anterior flagella, and the *Pentatrichomonas*, which has five.

Reproduction of the flagellate is by longitudinal division. The nucleus divides, the granule from which the flagella originate divides, a new undulating membrane is formed and a new stiffening rod grows out from the divided basal granule. The body of the flagellate with all the organs duplicated then splits, giving rise to

two daughter individuals. There is some doubt as to the reproduction of the axostyle, as some maintain that a new one is formed in each individual after absorption of the original one, while others think it divides longitudinally into two. As with the entamœbæ, the rate of successive divisions determines the size of the flagellate.

Trichomonas will survive for days after removal from the body, and even when none can be seen at first they will reappear after warming the fæces. They change in two ways; some of them degenerate by casting off and losing the various structures they possess, others without any such loss become spherical and motionless, and these, when warmed, will resume active life again. They are resistant bodies and will withstand the action of gastric juice for a considerable time, so that it appears probable that it is such contracted spherical forms which are responsible for the spread of infection, especially when it is remembered that definitely encysted forms are not known.

Those trichomonas which lose their various organs do so fairly regularly, and they assume a series of forms which may cause some confusion if not recognized. The first change is usually a breaking loose of the flagellum attached to the undulating membrane (fig. 23). It remains fixed at its point of origin, so that one has the appearance of an organism with one large thick flagellum and three finer flagella. The region of the membrane stills shows undulating movements. A further stage is the casting off of the large flagellum and the disappearance of the three finer anterior flagella. There is thus produced an irregular and constantly changing mass of cytoplasm, which still exhibits at one edge an undulating movement (fig. 24). These forms look like amœbæ with an undulating border, and it was undoubtedly these which led Castellani to describe the *Entamœba undulans* of the human intestine. Sometimes a peculiar movement is seen. At one end a long finger-like pseudopodium is suddenly thrown out. It moves backwards along one edge, getting shorter as it does so, till it completely disappears at the other end. Another one is at once formed, and the process is repeated at intervals of one or two seconds (fig. 25). Finally, it becomes a motionless mass of cytoplasm which is difficult to distinguish from a small *limax* amœba.

As regards the pathogenicity of *T. intestinalis* very little is known. The mere discovery of them in large numbers in diarrhœic conditions affords little evidence, as it is these very conditions which seem to favour their multiplication. It does not seem that in man infections are of long duration, for they have quickly

disappeared from the stools of individuals I have had under observation, and in this respect stand in marked contrast to infections with *Lamblia intestinalis*, *E. coli*, and *E. histolytica*, which appear to persist indefinitely. *Trichomonas* of the same or an allied species is often found in vaginal discharges. It seems most reasonable to assume this to be an invasion from the gut though the organism, which is larger than *T. intestinalis*, is generally given the distinctive name of *Trichomonas vaginalis*. One must always bear in mind the great variation in size of all the intestinal protozoa.

Trichomonas is very common in rats, mice, fowls, and other animals. Dr. A. C. Stevenson has shown me a section of the cæcum of a mouse in which there is a definite lesion of the mucous surface, which is being invaded by numerous *Trichomonas*. If such invasion can occur, probably through a surface broken by some other infection, or irritant such as sand, it is possible that the flagellates might aggravate the lesion or produce definite symptoms.

Escomel, working in South America, claims to have cultivated *Trichomonas* from cases of diarrhœa and to have produced infection with diarrhœa in dogs by injection of these cultures. Furthermore, he has claimed to have discovered the flagellate in the drinking water and that after clearing the reservoirs they were no longer found, while the dysentery ceased to be prevalent. This interesting work needs confirmation.

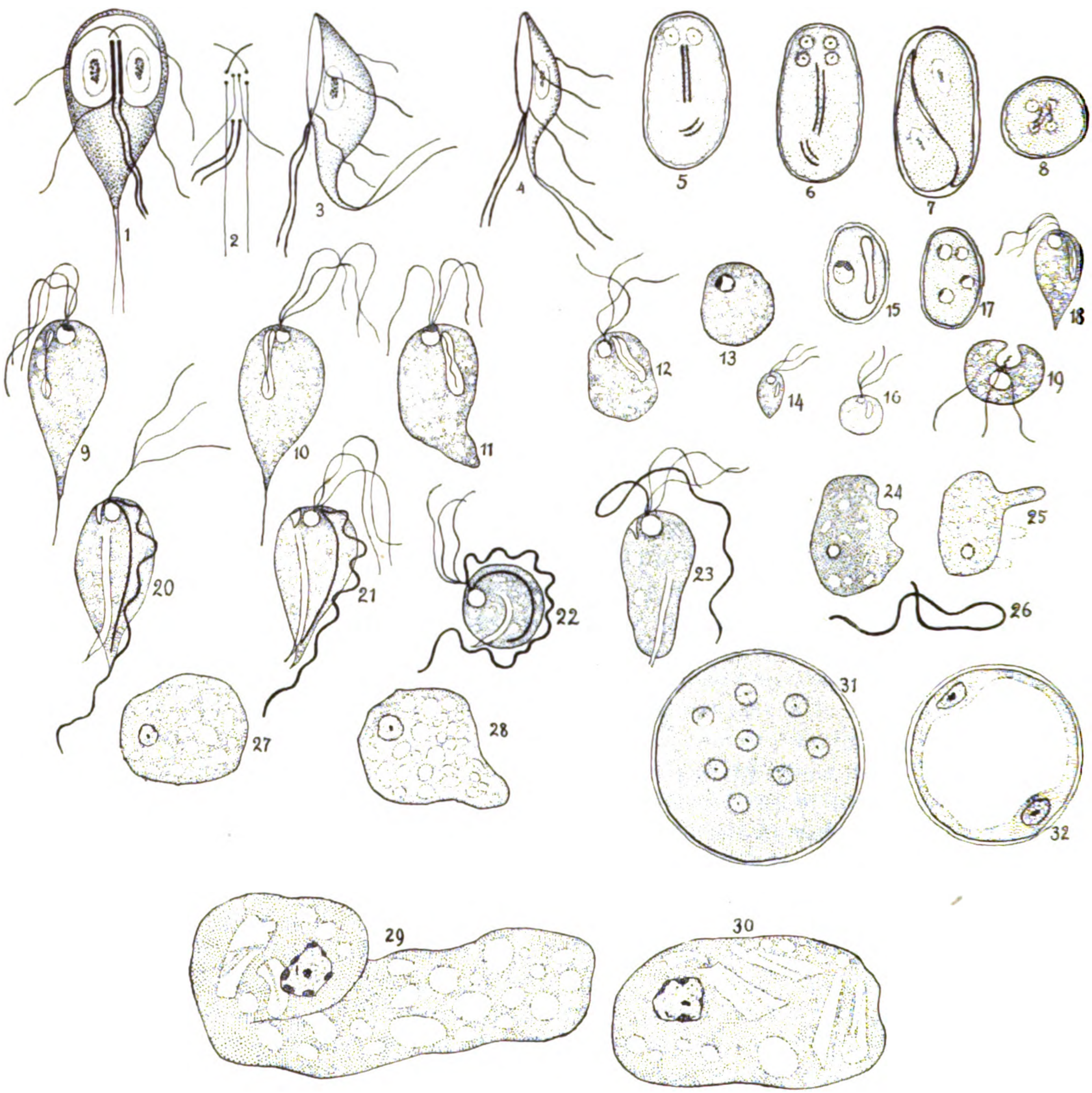
Lamblia intestinalis (figs. 1 to 8).

This flagellate is of fairly common occurrence and differs from other protozoa of the human intestine in that it lives in the upper part of the small intestine. In shape it resembles a pear split into two parts along the longitudinal axis. There is a flat surface on which there is a sucking disc with raised edge and a convex surface. The tapering extremity or tail can be turned over the convex back and it terminates in two flagella. There are three other pairs of flagella, the arrangements of which are best seen by referring to the plate. All four pairs of flagella originate in a paired rod-like organ occupying a central position in the flagellate. In stained specimens this paired rod-like structure can be resolved into a series of fibres and granules of a complicated nature, as shown in diagram (fig. 2). Two nuclei are present, one on each side of the rods, and these give the organism when viewed on the flat surface a curious face-like appearance. The flagellate swims rapidly and

on account of its shape moves about with a swaying motion in a manner reminding one of a flat-fish swimming in a tank of water. In the intestine it is able to rest on the surface of the epithelium with the flat, sucker-like disc applied to the cells and with its tail turned up over its back. Judging from the appearances I have seen in sections of the intestine of rabbits infected with *Lamblia* it would seem that the *Lamblia* invade the digestive glands of the mucous lining of the gut, where they can sometimes be seen sitting on the glandular epithelium in rows.

Lamblia intestinalis varies in length from about twelve to eighteen microns, and on account of its characteristic appearance there is little difficulty in recognizing it. It does not survive any length of time after escape from the body. At first very active, the movements gradually subside and consist only in lashings of the flagella. These gradually cease moving, but the two larger central flagella can often be observed gently undulating long after all other signs of life have disappeared.

Reproduction of *Lamblia* appears to take place only in the encysted condition. I have never seen an unencysted dividing *Lamblia*, though I have observed these organisms constantly for many years. Multiplication takes place in a cyst, which is formed in the upper part of the small intestine. The cyst, which is formed round a single *Lamblia*, is an oval structure about fourteen microns in length. It is quite transparent like the cysts of the *Entamœbæ*, so that the *Lamblia* can be seen within it. Within the cyst certain changes of a very complicated nature take place. Firstly, the two nuclei migrate to one end of the cyst and there divide, so that a total of four are present (figs. 5 and 6). The complicated flagellar apparatus is duplicated and two nuclei migrate to the opposite end of the cyst. The contents of the cyst divide to form two *Lamblia*, which can be seen in the cyst with the oblique line of separation between them (fig. 7). Apparently, if reproduction has proceeded thus far while the cyst is still in the small intestine it ruptures and the two daughter *Lamblia* escape and help to maintain the infection of the small intestine. If, on the other hand, the cyst has passed into the large intestine before complete development has taken place it ceases to develop further and is passed out to the exterior, where it awaits ingestion by a new host. If it gains entrance to the intestine of such a host the development is completed, and two *Lamblia* escape and bring about infection of the small intestine. The cysts of the *Lamblia* thus serve the double purpose of reproduction within the host and transmission of infection from one host to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DESCRIPTION OF FIGURES.

All the figures have been drawn to one scale as shown, with the exception of figs. 54 and 55, which are only half the size they should be. An ordinary human red blood corpuscle on same scale is shown at figs. 48 and 56 for comparison.

Lamblia intestinalis (figs. 1 to 8).

(1) Surface view showing sucking disc, two nuclei, and eight flagella.

(2) Origin of flagella as seen in stained preparations. They are represented as being more spread out than is actually the case.

(3) Side view of thick form.

(4) Side view of narrow form.

(5) Encysted form with two nuclei.

(6) Encysted form with four nuclei.

(7) Encysted form containing two flagellates.

(8) Appearance of cyst when viewed on end. The cysts are sometimes shorter in proportion to their breadth and much more definitely egg-shaped, with one end slightly narrower than the other, than represented in the plate.

Tetramitus mesnili (figs. 9 to 19).

(9) Form with overlapping lips of cytostome.

(10) Form showing flagellum in cytostome.

(11) Form in which posterior filamentous extremity is retracted.

(12) Still further retracted form.

(13) Rounded form in which flagella are lost, so that the resemblance to a small amœba is marked.

(14) Very small form of normal shape.

(15) Encysted form with single nucleus and cytostome visible.

(16) Very small round form.

(17) Possibly encysted form with four nuclei.

(18) Intermediate form of normal shape.

(19) Appearance of flagellate when viewed on end, the cytostome with the incurved lips shown clearly, as also the flagellum within.

Trichomonas intestinalis (figs. 20 to 26).

(20) Flagellate of normal structure; the three flagella appear to have a common base, possibly due to their being twisted round one another.

(21) Flagellate of normal structure; the three flagella are free in their entire length.

(22) Rounding off form with undulating membrane running round margin.

(23) Degenerating form; the large flagellum has broken loose from the undulating membrane, so that the flagellate has the appearance of having one large and three smaller flagella.

(24) Further degeneration; the flagella and axostyle are lost, so that the appearance is of an amœba with an undulating border.

(25) Amœboid form throwing out the finger-like pseudopodium, which rapidly passes down side of body into dotted position, where it disappears.

(26) Detached flagellum.

Entamœba coli (figs. 27 to 32).

(27) Small entamœba of roughly spherical form and vacuolated cytostome.

(28) Small entamœba forming pseudopodium with no distinction between ecto- and endo-plasm.

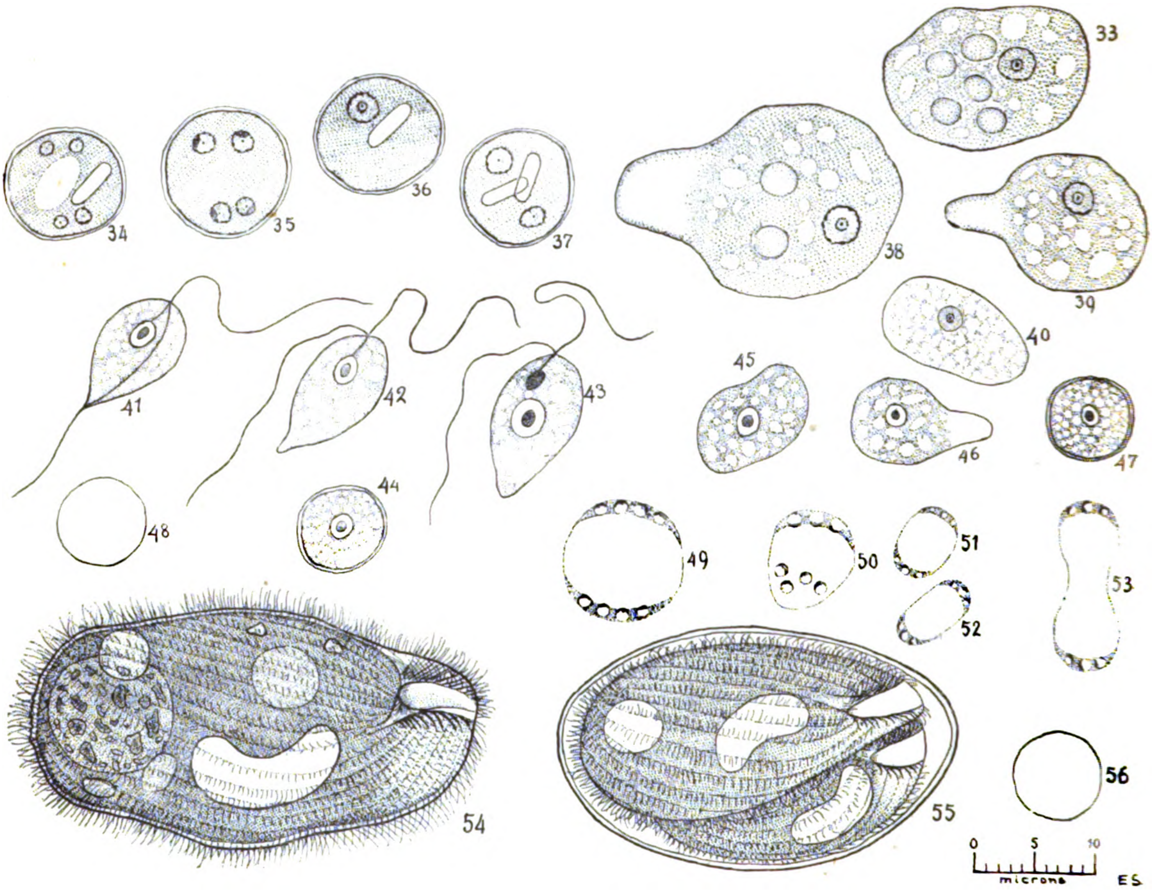
(29) Large entamœba of irregular shape.

(30) Large entamœba with slit-like rectangular vacuoles.

(31) Encysted form as it appears in the fæces. This is the form most commonly observed and which is most useful for diagnostic purposes.

(32) Encysted form of abnormal type with large central vacuole. In other cases there may be several vacuoles, and the vacuolation has the effect of retarding nuclear division, as such forms usually have only two or possibly four, nuclei.

In *E. coli* infections it is generally only the completely developed cyst with eight nuclei which is passed in fæces. The earlier stages of development with one, two, and four nuclei take place in the large intestines before the cysts escape.



Entamœba histolytica (figs. 33 to 40).

(33) Large tissue-invading form (*tetragena* form) containing five red blood corpuscles.

(38) Large tissue-invading form with ectoplasmic pseudopodium and containing two red blood corpuscles.

(39) Small form of intermediate size with ectoplasmic pseudopodium.

(40) Small *minuta* form as seen in post-dysenteric conditions.

(34) Encysted form with four nuclei, chromidial body, and vacuole.

(35) Encysted form with four nuclei. It is distinguished by its smaller size from the four-nuclear stage of *E. coli*, which, however, is rarely passed in the fæces.

(36) Encysted form with one nucleus and chromidial body.

(37) Encysted form with two nuclei and two chromidial bodies.

The encysted forms begin to appear as the acute dysenteric symptoms subside, and are thus very characteristic of the infection in carrier cases. It is important to note that they are much smaller than the cysts of *E. coli*. In *E. histolytica* infections it is usual to find passed in the fæces cysts in all stages of development.

Cercomonas, Bodo, Prowazekia (figs. 41 to 44).

(41) Cercomonas. The backwardly directed flagellum is adherent to the body. There is only a single nucleus.

(42) Bodo. The two flagella are free and there is only a single nucleus.

(43) Prowazekia. The two flagella are free and there are two nuclei.

(44) Encysted form of any of above three flagellates.

Amœba limax (figs. 45 to 47).

(45) Form without pseudopodium and characteristic *limax* nucleus.

(46) Form with pseudopodium.

(47) Encysted form.

(48) Red blood corpuscle to show relative size of objects in plate.

Blastocystis hominis (figs. 49 to 53).

(49) Large spherical form with several nuclei in semilunar protoplasm at opposite poles.

(50) Somewhat triangular form with many nuclei.

(51) Small oval form.

(52) Small elongated form.

(53) Elongated dividing form.

This organism is of a vegetable nature, but under certain conditions degenerating flagellates and small amœbæ or the encysted forms of these, by the development of a large central vacuole, will closely simulate the true Blastocystis.

Balantidium coli (figs. 54 to 55).

(54) Free ciliate as it lives in lumen of gut and in tissues.

(55) Encysted form containing two ciliates as passed in fæces.

(56) Red blood corpuscle as in fig. 48. It is represented as a corpuscle on an ordinary blood film where it is somewhat flattened out and appears larger than it really is (compare corpuscles within amœbæ in figs. 33 and 38).

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another. It is possible that two types of cyst exist, but the account I have given seems to be the simplest explanation of the appearances I have observed.

Individuals infected with *Lamblia intestinalis* often discharge encysted forms in the fæces in enormous numbers, and only pass the free-living flagellates if they have attacks of diarrhœa. *Lamblia* infection can easily be recognized by the finding of the characteristic cysts in the fæces. These are, as already explained, oval structures. With careful focusing with the $\frac{1}{12}$-inch oil immersion lens the nuclei, two or four in number, at one end of the cyst can be detected, while the two longitudinally arranged rods from which the flagella originate in the free flagellate give the appearance of a faint longitudinal striation. Within the cyst the line along which the cytoplasm touches the cyst wall often has a characteristic wavy appearance. In examining for *Lamblia* cysts it must not be forgotten that if the cyst is standing on end it will appear circular

in outline and might then be mistaken for other structures. The addition of iodine solution renders the contents of the cyst more prominent.

Lamblia intestinalis is a very persistent flagellate. I have had under observation two or three persons who have maintained their infection for years. One of these has an enormous infection and sometimes passes cysts in such numbers that as many as a dozen or more can be seen in a field of the $\frac{1}{12}$-inch objective. Many attempts have been made to get rid of this infection without result, but during the whole of this time there have been no signs of intestinal derangement. In other cases there occur at intervals attacks of diarrhœa with the passage of mucus in which *Lamblia* are to be found in enormous numbers, so much so that the whole microscopic field is packed with them. After recovery from such an attack the stools become normal again and only encysted forms are to be found. The occurrence of repeated attacks of this nature with a certain degree of abdominal uneasiness preceding the attacks and the passage of such extraordinary numbers of the flagellates, especially in the mucus, leads me to suspect that sometimes, at any rate, *Lamblia intestinalis* may produce sufficient irritation of the small intestine to justify us in regarding it as pathogenic. The invasion of the glands of the small intestine as seen in the rabbit is suggestive of such a pathogenic rôle.

In the way of treatment injections of emetine apparently have no effect. A case recently came under the notice of Dr. G. C. Low and myself. It was a man who was a carrier of *E. histolytica* and *Lamblia intestinalis*. He was passing large numbers of cysts of both kinds. He was treated by injections of emetine, which had the effect of completely ridding him of his entamœbic infection, but had no effect on the *Lamblia*. Subsequent treatment with large doses of β-naphthol reduced the infection, but failed to get rid of it; β-naphthol, however, appears sometimes to destroy a *Lamblia* infection of the intestine. Another case of *Lamblia* infection was treated by doses of emetine in capsules by the mouth, also without result. This case again failed to respond to treatment with β-naphthol. The somewhat drastic treatment adopted for the destruction of *Ankylostoma duodenale* in the duodenum has also failed to destroy completely the *Lamblia* in the small intestine. It is possible that the forms in the cavity of the gut come under the influence of the drug, while such as are lurking in the tubular glands escape entirely, and are responsible for the re-establishment of the infection after treatment had ceased.

Tetramitus mesnili (*Macrostoma mesnili*) (figs. 9 to 19).

This is a flagellate which was first found by me a few years ago in the intestine of a man who had come to London from the Bahamas. He had been admitted to the Albert Dock Hospital for some chest complaint, and the flagellate was only discovered in the course of routine examination.

In general shape, size, and the possession of three long fine anterior flagella it resembles *Trichomonas intestinalis*. It differs, however, in having no undulating membrane and no axostyle. It has, on the other hand, a large cytostome in the form of a longitudinal slit, which runs from the anterior end along half or two-thirds of the body length. The cytostome has a sharp margin which is sometimes produced into lips which appear to overlap one another (fig. 9). Within the cytostome is a longitudinal flagellum, which seems to be attached to the border of an undulating membrane (fig. 10). The cytostome flagellum and the three anterior flagella all arise from a granule which lies just anterior to a spherical nucleus near the anterior end of the cytostome. The posterior end of the animal is pointed and may sometimes be drawn out to a length equal to, or greater than, that of the body itself. The cytoplasm is generally very vacuolated and contains bacteria, which seem to be the staple article of diet. The size of the flagellate varies considerably, there being minute forms three or four microns in length, and every intermediate gradation up to individuals with a length of about fifteen microns.

There seems to be some doubt as to the method of reproduction of *Tetramitus mesnili*. I have never seen an undoubted dividing form in a stained film, but some such method of multiplication must occur, and the presence in fresh preparations of specimens with two tail-like prolongations may be an indication of multiplication by simple longitudinal division such as occurs in the case of *Trichomonas*.

Encysted forms of *Tetramitus* are produced in the shape of oval transparent cysts seven to eight microns in length (fig. 15). Within the cysts the characteristic features of the *Tetramitus* can be seen. The future of these cysts is probably escape from the body and transmission of infection to other individuals, as with so many of the intestinal protozoa. In some preparations I have seen cysts in which a single nucleus has divided twice to produce four nuclei, so that it seems probable that after encystment multiplication takes place within the cyst (fig. 17). The

development of the cysts of *Tetramitus* and its method of multiplication within the gut require further study.

Tetramitus mesnili is readily seen with the one-sixth inch objective. It can most easily be confused with *Trichomonas*, though the undulating membrane of the latter and the large cytostome of the former should prevent such an error. The counting of the three anterior flagella offers the greatest difficulty, and, as with *Trichomonas*, they are most clearly seen with dark-ground illumination. This method of observation also affords the clearest view of the movements of the flagellum within the cytostome—a flagellum which is so difficult to detect with ordinary transmitted light that some have even denied its existence.

Like other flagellates of the intestine the activities of *Tetramitus mesnili* are greatest in fæces which have been freshly passed. Soon the movements become less active and finally cease completely. *Tetramitus* survives in fæces only a few hours, and in this respect is quite unlike *Trichomonas*, which may survive for days. The normal pear shape of the organisms is quickly lost and all kinds of distorted forms soon appear (figs. 11 and 12). Some lose their flagella and contract till they are mere spherical masses of cytoplasm, which are then practically indistinguishable from the spherical forms of *Trichomonas* or of small amœbæ of the *limax* type. It is possible that this assumption of the spherical form has to do with an attempt at encystment, but the actual encystment of such forms has not been observed.

Tetramitus mesnili was first discovered by me in a man with no intestinal symptoms. Since then it has been found to have a very wide distribution in tropical and sub-tropical countries, and certain small epidemics of diarrhœa have been attributed to this flagellate. In all these cases in which *Tetramitus* and, indeed, all intestinal parasites are present, the greatest care should be taken to exclude all bacterial infections such as typhoid, paratyphoid, dysentery, etc., for the very gut conditions produced by these bacteria may be the cause of inducing an active multiplication of perfectly harmless flagellates.

Cercomonas, Bodo, Prowazekia (figs. 41 to 44).

There are three other flagellates which should be mentioned as they occur, though in my experience very rarely, in the human intestine. These are species of *Cercomonas*, *Bodo* and *Prowazekia*. It is doubtful if they are true parasites like the flagellates described above, for they correspond very closely and are possibly identical

with free-living forms which are often to be found in wet, decomposing material. They will often appear in fæces which have been kept a few days, though they could not be detected in the freshly passed fæces. They are all three slightly elongated flagellates up to 15 microns in length, with a blunt anterior end and a tapering posterior end. They each possess two flagella, one of which is directed forwards in movement, while the other trails backwards. Both flagella take origin at the blunt anterior end of the body. In both *Bodo* and *Prowazekia* (figs. 42 and 43) the two flagella are free, while in *Cercomonas* (fig. 41) the trailing or backwardly directed flagellum is attached to the surface of the body as far as the posterior end of the flagellate, when it is continued as a free flagellum. *Cercomonas* and *Bodo* have each a single nucleus, consisting of a nuclear membrane and large central karyosome. The flagella appear to take origin from the nuclear membrane. In *Prowazekia* (fig. 43), on the other hand, there are two nuclei, from one of which the flagella arise. The general structure of these flagellates will be seen on the diagram.

The three flagellates just described have probably no pathogenic significance whatsoever, and are to be regarded as free-living forms which have taken up a temporary abode in the gut. They are very readily cultivated on agar or liquid media in which bacteria are growing and there may become encysted in small spherical cysts 6 to 8 microns in diameter (fig. 44). They probably all have an amœboid stage indistinguishable from *Amœba limax*. The cysts are probably responsible for the occasional appearance of the flagellates in the intestine of man, for cysts of these forms constantly pass through the intestine, and it is the flagellates which escape from these cysts in fæces that are kept for a few days which give rise to the cultures of flagellates. Like the small *limax* amœbæ described above, they may occasionally escape from their cysts while they are still in the large intestine, and thus give rise by rapid multiplication to a temporary infection of the gut.

That these forms are of rare occurrence is shown by the fact that only in one case in ten years' experience of examinations for intestinal protozoa have I come across undoubted *Cercomonas*. I must make one remark about the name *Cercomonas*, which is used very loosely in medical literature. It has become a habit with some to call any actively moving flagellate seen in fæces a *Cercomonas*, quite regardless of the fact that the true *Cercomonas* is a flagellate of very definite structure. In the diagnosis of intestinal flagellates it is absolutely essential to see clearly the structure and

number of flagella, for without these data it is impossible to arrive at a clear idea of which flagellate one is dealing with. To one experienced in the examination of such organs the ordinary transmitted light will be sufficient, but, as already mentioned above, the dark-ground illumination is a great help. Staining may be of some assistance, and I will give at the end of this paper some general directions for carrying out this process for intestinal protozoa.

Balantidium coli (figs. 54 and 55).

This protozoon is a member of the group Ciliata, and is the only common ciliate of the human intestine. It appears to be a normal inhabitant of the intestine of pigs, and those who have to deal with these animals are most liable to infection. It inhabits the large intestine of man, and has the power of boring its way into the mucous coat and producing extensive ulceration, very much as *E. histolytica* does. It is sometimes found in the mesenteric glands draining the ulcerated areas. The condition produced by this ciliate is known as balantidial dysentery.

Balantidium coli is a large organism varying considerably in size, according to Brumpt. Its length may be anything from 30 to 200 microns and its breadth 20 to 70. On an average it is about 50 to 100 microns in length. It is thus a much larger organism than any of the other intestinal protozoa. It has an ovoid body which is slightly narrower at the anterior than at the posterior end. There is a cytostome opening at the anterior end; the whole body is covered with longitudinal rows of cilia which are longest around the cytostome. There is a large nucleus which is usually elongated and slightly curved (horseshoe-shaped), the macronucleus and a smaller nucleus, the micronucleus, which is generally hidden in a depression in the macronucleus. There are present in the cytoplasm two contractile vacuoles which pulsate at intervals, while there occur a varying number of food vacuoles of different sizes. Food is taken in through the cytostome and passes into vacuoles in the cytoplasm, where digestion takes place. Undigested particles of food are thrown out from the posterior end of the animal at the anus, which is only visible at the moment of extrusion of any particle.

These large ciliates swim about amongst the intestinal contents by means of their cilia, while the anterior narrower end exhibits a certain amount of change of shape as if the creatures were feeling their way through the débris. Multiplication both in the gut cavity and in the invaded tissues takes place by transverse

division, the nucleus first dividing into two parts. When multiplication is proceeding rapidly there may result small individuals not more than 30 microns in length, as Brumpt has shown in the case of experimental infection in monkeys.

As with other intestinal protozoa, cysts are produced, which are responsible for the infection of new individuals. According to Brumpt, these cysts may be formed round single *Balantidia*, or two may enter a single cyst. In the latter case a conjugation takes place by fusion of the two ciliates. The cysts of *Balantidium* are roughly spherical or oval structures about fifty to sixty microns in diameter; they can be recognized by the ciliated organism within.

Balantidium coli is such a large and characteristic organism that there can be no difficulty in its recognition. It might possibly be confused with ciliated embryos escaping from worms' eggs if careful observation is not made.

Other ciliates have been met with in the intestine of man, but many of these are only accidental infections with ciliates which usually live in water and are in no way parasitic. A small ciliate measuring 20 to 30 microns in length was described by Schaudinn from the human intestine under the name of *Balantidium minutum*. It has the same general structure as *Balantidium coli*. Another described by the same author is *Nyctotherus faba*, a ciliate with a lateral instead of a terminal cytostome. Both of these ciliates are of rare occurrence and are probably of no pathological significance.

Blastocystis hominis (figs. 49 to 53).

The description given above includes all the protozoa which are likely to be encountered in the intestines of people returning to this country from tropical or subtropical countries, but it must be remembered that fæces contain vegetable cells, yeasts, and other bodies which must not be confused with encysted protozoa. One such organism of a vegetable nature is known as *Blastocystis hominis*. It is a more or less spherical structure which varies in diameter between 5 and 15 microns, and may fairly readily be mistaken by the inexperienced for encysted *E. coli* or *E. histolytica*. The Blastocystis is a very much more flimsy structure with more delicate capsule than the cysts of entamœbæ. The great part of the cyst content is a large vacuole which reduces the cytoplasm to a narrow rim at one or often two poles of the cyst. In this narrow, greenish rim of cytoplasm are to be seen a varying number of

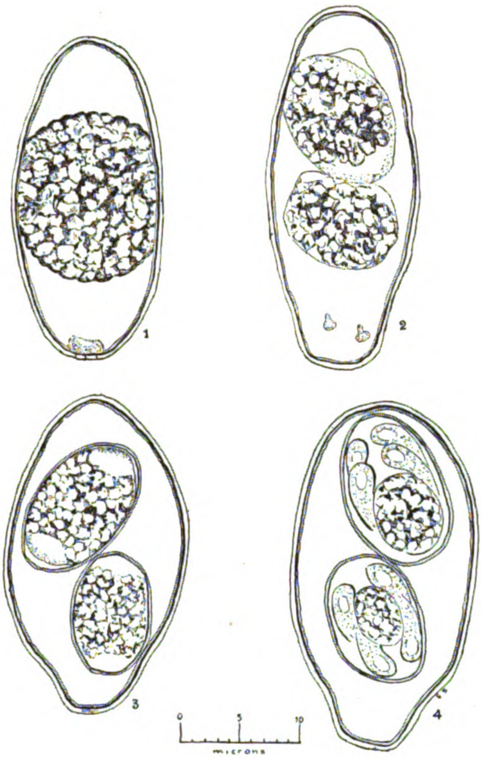
refractile, greenish spots which are really nuclei. These spherical Blastocystis may become elongated and divide transversely into two parts. Alexeieff regards them as vegetable organisms allied to the yeasts. Sometimes they occur in enormous numbers in the stool—hundreds being present in an ordinary field of the one-sixth inch objective. Some have regarded them as cysts of *Trichomonas*, but in my experience this view is not tenable, for I have encountered them on so many occasions in large number when there was no trace of *Trichomonas*. It is quite possible, however, that under certain conditions such a structure as the spherical cyst of a small *limax* amœba, by developing abnormally a large central vacuole, such as occurs occasionally in the cysts of *E. coli*, may come to resemble a true Blastocystis. On occasions it has seemed to me that degenerating *Trichomonas* or *Tetramitus* may become centrally vacuolated and resemble Blastocystis, and in this connexion it is interesting to recall that Dobell thought that similar structures which he encountered in the intestines of frogs had been derived from degenerating red blood corpuscles of these animals. However this may be, there is a true Blastocystis which can multiply by division into two parts or occasionally by multiple division as claimed by Alexeieff, and it is these forms which, being exceedingly common in the human intestine, especially of those who have lived in warm climates, must be carefully distinguished from encysted protozoa.

Coccidiosis.

Dr. H. M. Woodcock[1] has called attention to certain bodies he had found in the fæces of some of the cases from Gallipoli. These were elongated cysts containing one or two masses of protoplasm. He considered them to be oöcysts of a coccidium and thought they were related to the isospora. He was unable to obtain any further development of the bodies, so that their coccidial nature was unproved. Since Woodcock's paper appeared Dr. G. C. Low has come across one case and I have seen three others at the London Hospital. In the fæces of one of these kept at the laboratory temperature the cysts have completed their development in three to four days. The single mass of protoplasm contained by the oöcysts divides into two sporoblasts, which in their turn become enclosed in oval sporocysts. Within the sporocyst each sporoblast now divides into four sporozoites and a large residual body, so

[1] *British Medical Journal*, November 18.

that the fully developed oöcyst contains two sporocysts, each of which contains a residual mass of cytoplasm and four sporozoites. The oöcyst when passed in the fæces contains the single mass



Human Coccidiosis.

Extracorporeal development of the human coccidium. The intracorporeal development of the coccidium takes place in the epithelial cells of the gut, there being an asexual cycle followed by the production of male and female sexual forms. Fertilization of the female gamete takes place in the gut and the zygote so formed becomes closed in an oöcyst, which is passed in the fæces and completes its development on the ground or in water. The first stage in the development is the retraction of the protoplasm so that it does not completely fill the cyst (fig. 1). Next, two sporoblasts are produced (fig. 2) by division of the single mass, and then each of these becomes enclosed in a sporocyst (fig. 3). The final stage is the production in each sporocyst of four sporozoites and a residual mass of cytoplasm (fig. 4). When this stage is reached, and not till then, the oöcyst is infective, and if swallowed the sporozoites escape, enter the epithelial cells of the gut, and recommence the asexual cycle. The oöcysts of coccidia are generally very resistant structures which can withstand a great amount of drying.

of protoplasm. The wall of the oöcyst shows a marked double contour and within it what appears to be a fine lining membrane. One end of the oöcyst often shows a narrowing just before the

end is reached, and at this end there is some indication of an opening, a micropyle through which in all probability the male gamete enters to effect fertilization. The micropyle is sometimes seen covered on the inner surface by a plug. The development, which I have followed, proves that Woodcock's conjecture was correct, and that these structures are really coccidia and belong to the genus Isospora, one member of which is a parasite of the intestines of cats and dogs, and another of the kidneys of frogs. As the coccidium develops in the intestinal epithelium it, of course, brings about destruction of the epithelial cells themselves, and so must be regarded of some pathogenic importance, although the symptoms of human intestinal coccidiosis have not been definitely determined. In animals such infections are often the cause of serious enteritis, which may have a fatal termination.

Methods of Examination.

The intestinal protozoa are best examined fresh and living and so soon after leaving the body as possible. The encysted forms protected by the cyst do not change and can be satisfactorily studied days after they have been passed, but the unencysted motile forms quickly change and degenerate, so that after some hours it it may be a matter of great difficulty to identify them. As I have already remarked, it is better to examine several thin preparations of diluted fæces than one thick one, and if the fæces are perfectly fresh there is no necessity to use a warm stage, which may even be a disadvantage in causing the flagellates to move too rapidly for satisfactory observation. If the fæces are old a warm stage may revive amœbæ or flagellates which have ceased to move and thus help diagnosis.

Practically all details of structure which I have described above can be seen in the living forms, and there is no need to prepare stained preparations for this purpose. Great assistance in the diagnosis of flagellates is derived from the use of the dark-ground illumination.

Another point worthy of note is that the protozoa degenerate much more rapidly if the fæces be kept warm in an incubator. It is probably due to more rapid action of the bacteria at higher temperatures. Accordingly, if it is impossible to examine a specimen at once it is better to preserve it in the cold, and only warm it on the stage at the time of observation.

Often in dealing with the encysted forms of protozoa in fæces

it will be found that the nuclei within the cysts are difficult to distinguish. This is especially the case with the cysts of *E. histolytica* or *Lamblia.* The following method will be found useful in bringing the nuclei into greater prominence. A small drop of iodine solution (Weigert's solution = iodine 1, potassium iodide 2, distilled water 100) is placed on a slide and some of the fæces to be examined is rubbed in it by means of a match or platinum loop to give a yellow emulsion. A cover-glass is placed on it and the preparation examined at once. The cysts are stained a light-brown colour, and the nuclei, which may have been invisible before, now stand out clearly and can readily be counted.

If it should be desired to make permanent stained preparations the most satisfactory results are obtained by using some method of wet fixation. Ordinary dried smears stained by Giemsa stain will sometimes give fairly good pictures of the flagella of Lamblia or other flagellates, but, as a rule, so much distortion takes place that it is almost impossible to recognize the organisms.

The following method has given me very good results. A thin smear of the fæces, diluted if necessary, is made on a cover-glass and this is dropped without drying, film side downwards, on to a fixing fluid. A very good one consists of a mixture of two parts of saturated watery sublimate and one part of alcohol. The cover glasses float on the surface of the fixative and are allowed to remain there for twenty to thirty minutes. They are then carefully removed and placed in a Petri dish of thirty per cent spirit (this time film side up) in order to remove the sublimate. Great care must be taken to prevent them scraping against one another. After a few minutes' washing in this manner in several changes of the alcohol they are placed in distilled water and are ready for staining, and are to be treated as if they were sections. The best results are obtained by staining with iron hæmatoxylin. The films are left to soak for some hours (during the day or over night) in a four per cent solution of iron alum. They are then washed for a second or two in distilled water and placed in Heidenhain's hæmatoxylin,[1] in which stain they become quite black. They are left there for several hours as before. The black films are then washed in distilled water and placed in a one per cent iron alum

[1] To prepare the stain dissolve 1 gramme of hæmatoxylin crystals in 10 cubic centimetres of absolute alcohol by warming; add 90 cubic centimetres distilled water and allow to mature for a week to ten days, and then add a further 100 cubic centimetres distilled water.

solution, which commences to dissolve the black stain. The differentiation must not be carried too far, and in order to control it the films must be examined every few minutes in distilled water with a water immersion lens or with the ordinary $\frac{1}{6}$-inch objective. The success of the method depends on the right degree of differentiation, and in examination of the films it is essential to see the actual objects which are being stained, for objects vary in the amount of extraction required. The nuclei should show clearly as black rings. Experience alone can teach the right degree of extraction of the stain. As a rule, a flagellate film should not take longer than five to ten minutes for differentiation in one per cent iron alum solution. Objects like encysted forms of course take longer. When differentiation is complete the films are washed in distilled water and taken up through strengths of alcohol to absolute alcohol. They are then cleared in xylol and mounted in balsam. By this method of fixation and staining permanent preparations are obtained while the actual shape and structure of the organism are preserved and often every detail can be readily seen.

It is essential to have constantly at hand an eye-piece fitted with a micrometer scale, the size of the divisions of which is known in microns for each power of the microscope and for a definite tube length. If any object, as for instance a cyst of *E. coli*, is found, its size can at once be determined by inserting the micrometer eyepiece. The actual size of the divisions of the eye-piece scale is discovered by examining with this eye-piece the micrometer slide, on which a scale in tenths and hundredths of a millimetre is marked. It will be found that each division of the eye-piece scale with the $\frac{1}{12}$-inch objective represents, say, 1·7 microns, and this is a constant factor which can be used at a moment's notice. With lower powers the value of each division will be correspondingly greater. It is much better to have a special eye-piece for this purpose so as to obviate the necessity of inserting the scale when required.

In the above description I have given an account of the common protozoa of the human intestine as I have seen them in the course of many years' observation, and it is hoped the description will be of some assistance not only to those who deal with the examination and treatment of cases in Egypt, Mudros, the Peninsula, and Mesopotamia, but also to others having under their care men in this country who have returned from localities where these infections are likely to be contracted.

I have recently seen a good many instances of protozoal infections of the gut in cases returning from Gallipoli in hospitals both in London and the provinces. *E. coli* is very common in these men, and also the flagellates *Trichomonas, Tetramitus* and *Lamblia*. No case of *Balantidium* infection has come under my notice, but one case has been recorded recently in Egypt. On the other hand, the vegetable organism *Blastocystis* occurs in large numbers in these cases, while occasionally I have seen a small amœba of the *limax* type. I have seen only four cases of *E. histolytica* infection, and this is all the more gratifying, for I hear from Lieutenant-Colonel A. Balfour that such infections are far from uncommon out there, but that they are in most cases immediately cut short by suitable treatment with emetine. This speaks well for the wonderful action of this drug in killing off the pathogenic entamœba and so preventing that formerly too common sequel of the disease, amœbic abscess of the liver.[1]

APPENDIX.

In addition to the organisms found so frequently in the human intestine there has appeared in the fæces of some of the cases from Gallipoli a spherical body which is usually smaller but may be equal in size to the cysts of *Entamœba histolytica*. It is probably of a vegetable nature and in fæces kept for some time there is an indication that it elongates and may reproduce by simple division or even grow into filaments or hyphæ. It may thus be the spore of a fungus, but its importance is that it can be mistaken, especially when it is large, for the cysts of the pathogenic entamœba. It is shown in the photomicrographs 7 and 8 of the plate. Each cyst has a single nucleus which is much smaller than the nucleus of the single nuclear stage of the *E. histolytica* cyst. In addition to the nucleus which appears in the fresh condition as a small granular ring there are one or more refractile bodies of varying size which again bear some resemblance to the chromidial bodies seen in cysts of *E. histolytica*. These bodies are very strongly iodophilic and in preparations of fæces made with Weigert's iodine solution they become a dark brown, almost mahogany colour, as shown in the

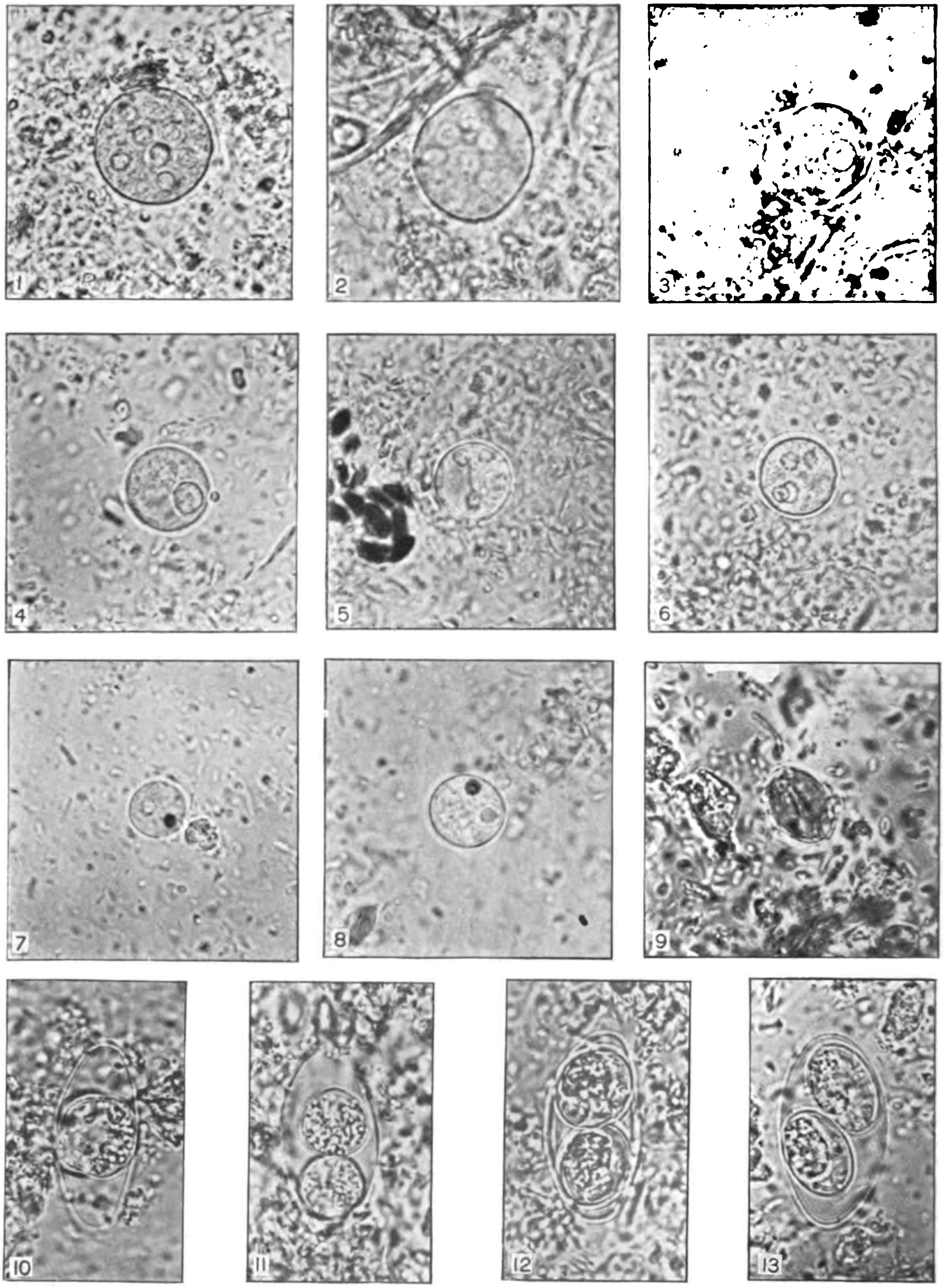
[1] Since writing the above I have extended my observations on men returned from Gallipoli and I have found that approximately ten per cent are harbouring *E. histolytica*, mostly as carrier cases.

photomicrographs 7 and 8. The iodophilic body or bodies are often much larger and more irregularly shaped than shown in the plate.

The photomicrographs shown in the two plates have been made by Dr. A. C. Stevenson at the Wellcome Bureau of Scientific Research and they show more clearly and naturally than any drawing is able to do the appearance of some of the protozoal organisms of the human intestine. The photographs in Plate II show the invasion of the tissues by *E. histolytica* and *Balantidium coli* and it will be seen how these organisms spread into the submucous coat of the bowel. The photographs in Plate I are very excellent reproductions of the actual appearance of many of the cysts as they occur in fæces either mixed with iodine solution or with normal saline and they should be of great assistance to those who have to identify these bodies in fæces.

There still remains to be recorded another coccidium which I have found in one case from Gallipoli. A description of this form will appear shortly in the *Lancet*. It is quite distinct from the Isospora described above, and is a species of Eimeria (Coccidium), for the spherical oöcyst, which measures 20 microns in diameter, contains when mature four sporocysts, each of which encloses two sporozoites and a residual mass of cytoplasm. This coccidium resembles most closely *Eimeria falciforme*, a parasite of the intestine of the mouse.

PLATE I.



To illustrate "Observations on the Common Intestinal Protozoa of Man: Their Diagnosis and Pathogenicity," by C. M. WENYON, M.B.

PLATE I.

Various Cysts from Human Fæces.

Nos. 1 and 2 and 4 to 9 are from preparations of fæces rubbed up in Weigert's iodine solution. Nos. 3 and 10 to 13 are from fæces in normal saline solution. The magnification is about 1,000 diameters.

(1) Cyst of *Entamœba coli*, showing five nuclei clearly and two less definitely.

(2) Cyst of *E. coli*, showing five or six nuclei.

(3) *Minuta* form of *E. histolytica* with ectoplasm and endoplasm.

(4) Cyst of *E. histolytica* with one nucleus.

(5) and (6) Cysts of *E. histolytica* with four nuclei.

(7) and (8) Cysts probably of vegetable nature, each with single small nucleus and dark iodophilic body.

(9) Cyst of *Lamblia intestinalis*.

(10) to (13) Human coccidium, showing extracorporeal development into two sporocysts, each with four sporozoites.

PLATE II.

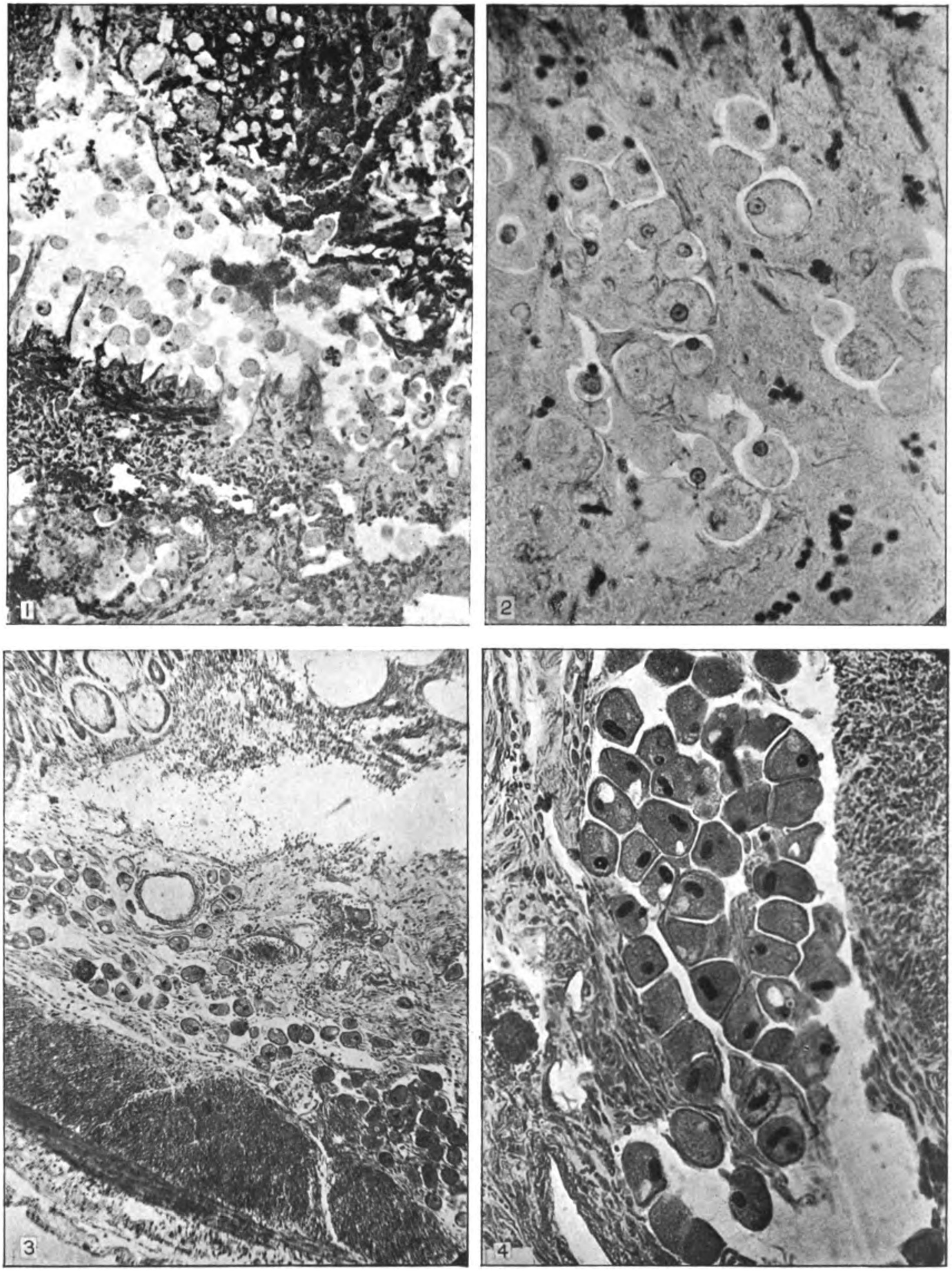
(1) Section of gut in experimental infection of cat by *Entamœba histolytica*, showing destruction of muscularis mucosæ and passage of entamœbæ from mucous to submucous coat. × *circa* 120.

(2) Section of very early ulcer in gut of cat showing entamœbæ in necrosed mucosa. × *circa* 500.

(3) Spreading edge of ulcer in balantidial dysentery of man. The Balantidia lie in the deep layers of the submucosa in the comparatively healthy tissue around the ulcer. × *circa* 55.

(4) Mass of Balantidia from similar section of human intestine. × *circa* 120.

PLATE II.



To illustrate "Observations on the Common Intestinal Protozoa of Man: Their Diagnosis and Pathogenicity," by C. M. Wenyon, M.B.

SOME CLINICAL OBSERVATIONS ON CEREBROSPINAL FEVER.

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and

Captain R. G. ABRAHAMS.

Royal Army Medical Corps.

BACTERIOLOGY.

By Major SYDNEY ROWLAND.

Royal Army Medical Corps.

From January of this year up to the time of writing, one hundred and sixty-one cases of cerebrospinal fever have been admitted to this hospital. These cases have been gathered from various units in the field and it is noteworthy that from this number in very few instances have more than one or two cases occurred in the same unit. In this paper we do not desire to discuss at any length those signs and symptoms of the disease which are, by this time, familiar to many, but there are just a few points noted by us during the epidemic that we feel should provide interest.

First, a few words as to the carrier problem. It is well known that during epidemics of cerebrospinal fever there are a certain number of apparently perfectly healthy individuals, living either in close contact with actual cases of the disease, or remote from the latter, in whom bacteriological examination of the secretion of the nasopharynx reveals the presence of the meningococcus. These so-called carriers are found at other times when cases of the actual disease are not occurring. Whether carriers are more prevalent during an epidemic than they are during a normal period is a point that we have not had an opportunity of investigating.

Coincident with the admission of our cases to hospital, fifty immediate contacts were also admitted. In each case naso-pharyngeal swabs were taken, and in six instances an organism was isolated so closely resembling the meningococcus of Weichselbaum as to be indistinguishable from the latter—that is to say, twelve per cent of the immediate contacts were in all probability carriers.

Although these latter men were isolated from their respective units and sent as soon as possible to the Base no marked decrease was ever noted in the number of actual cases occurring in the few days following their isolation. We think it only natural to assume

therefore that the carriers responsible for the spread of the infection are not necessarily confined to immediate contacts, but that almost certainly many others are infective, though how it is difficult to say, when it is borne in mind that in this particular form of meningitis not one undoubted case of transmission of the disease by direct contact has been proved.

Is the Disease Contagious?

If the word contagious is used in its ordinary meaning we feel obliged to answer this question in the negative. In our experience no case of the disease has occurred among nurses, nursing orderlies, or medical officers attendant on the cases, although latterly no special precautions to avert infection by contact have been taken by the latter. Curiously enough no suspected carriers were ever found among the persons attending the cases, bacteriological examinations of nasopharyngeal swabs taken from time to time proving in all cases negative, although at the same time, as mentioned above, quite a number of carriers were isolated from units in the field.

Diagnosis of the Disease.

Except in very acute or fulminating cases, when diagnosis is obvious, much difficulty has been experienced both by ourselves and by others in coming to a definite conclusion in many cases, especially in the early stages of the disease.

Ample evidence of this is provided in the following statement: Between April 8 and June 2, 109 cases were sent into this hospital either diagnosed as cerebrospinal fever or as suspected cases; of these 43 (that is 39 per cent) were ultimately found to have the disease.

The diseases with which we have experienced greatest difficulty in differentiating from cerebrospinal fever are as follows:—

Influenza.
Some early cases of enteric fever (both true typhoid and para. B).
Acute mania.
A few cases of sub-acute rheumatism.

Besides these conditions the following diseases—examples of which have been transferred to us as possible cases of cerebrospinal fever—also demand attention when diagnosis is being considered:—

Chronic nephritis with uræmic symptoms.
Pneumococcal septicæmia.
Acute irritant poisoning.
Hysteria simulating meningitis.

Cases of état méningitique (of some French authorities), or "simple meningitis" (to be described below and of doubtful origin, no micro-organism having yet been isolated in such cases).

Differential Diagnosis.

Influenza.

Severe cases of this disease have presented the greatest difficulty of all. Many cases of cerebrospinal fever begin with symptoms practically identical with those usually associated with the disease known as influenza, and it is not until perhaps several days have elapsed that definite symptoms pointing to a meningeal affection make their appearance. On the other hand influenzal meningitis is a very definite complication of a few cases of severe influenzal infection. Both patients suffering from influenza and cerebrospinal fever in the early stage may complain of sore throat, headache, backache, general lassitude and feeling of weakness, shivering and vomiting.

The following points of difference in the two diseases have been used by us in attempting to arrive at a correct diagnosis.

(1) *Relation of Pulse-rate to Temperature.*—In influenza the pulse is usually increased in rate, but at the same time somewhat slow in proportion to the degree of pyrexia, rising to eighty or ninety beats per minute with a temperature of 102° to 103° F. at the onset.

In cerebrospinal fever the pulse is usually exceptionally slow at the onset—slow out of all proportion to the temperature—it being quite common to find a rate of anything from fifty to seventy beats per minute with a temperature of 102° to 103° F., or even much higher.

(2) *Other Differences in the Pulse.*—The pulse in an influenzal infection is usually soft, of low tension, and frequently irregular in force and rhythm, while that in cerebrospinal fever is as a rule, full, of moderately high tension and regular.

(3) *Very frequent occurrence of irregular ciliary hyperæmia* of the eyes in cases of cerebrospinal fever, not seen in cases of influenza.

(4) *Tongue.*—A very dry, dirty, furred tongue, almost brown, a few hours after onset in cerebrospinal fever. This is not noticed in cases of influenza.

(5) *Blood-count.*—Leucocytosis is a prominent and early feature of cerebrospinal fever. Influenzal affection, on the other hand, produces no leucocytosis, but usually a leucopænia.

The leucocytosis is high, varying from 16,000 to 35,000 in our cases.

(6) *Lumbar Puncture.*—Except in a few cases, this procedure always gave us the information we required. In a few cases, however, the cerebrospinal fluid obtained by lumbar puncture for the first time was perfectly clear and showed no increase in cellular elements at all (a cell count being made on a hæmocytometer slide, fifteen cells per cubic millimetre of cerebrospinal fluid being taken as a normal average count); moreover, bacteriological examination of the fluid proved negative. In a certain proportion of these cases the cerebrospinal fluid became turbid within another few hours, when a second lumbar puncture was performed and bacteriological examinations proved positive. However, in one case at least presenting very definite signs and symptoms of cerebrospinal fever, cerebrospinal fluid on several occasions proved absolutely negative both cytologically and bacteriologically.

Enteric Fever.

Onset usually much less abrupt, and malaise at the commencement much less severe than in cerebrospinal fever. Tongue becomes gradually coated with a brown fur. Blood-count shows a leucopænia.

Blood Culture.—The isolation of an organism from the blood belonging to the enteric group, though important, may take some days to complete, and hence does not aid very much in the differential diagnosis between enteric and cerebrospinal fever in an early stage.

It is interesting to note that in a few cases of cerebrospinal fever the meningococcus has been demonstrated in a culture from the blood.

Lumbar puncture is usually conclusive.

Acute Mania.

Especially important to us, in that we were dealing with men who have in many cases been subjected to extreme mental and physical fatigue. On two occasions we were obliged to perform lumbar pnncture in order to satisfy ourselves that we were not dealing with one of the most severe types of cerebrospinal fever characterized at the onset by a mental state resembling acute mania.

Sub-acute Rheumatism.

The history of previous attacks is important. Pains are usually confined to the joints of limbs. Malaise not severe. No vomiting.

Lumbar puncture may be deemed advisable in doubtful cases.

Diagnosis by Lumbar Puncture.

In all but one of our cases we were able to confirm our diagnosis by an examination of the cerebrospinal fluid. In one case death occurred before lumbar puncture could be performed, but diagnosis in this case was confirmed post-mortem.

In one hundred and sixty cases the cerebrospinal fluid was shown to contain a large number of polymorphonuclear leucocytes, and in one hundred and seventeen of these intra-cellular diplococci were seen. In addition to this the cerebrospinal fluid in every case examined also showed a marked increase in the cells of the lymphocyte class, both small and large types being represented. The diagnosis having been definitely established, the occurrence of the following signs and symptoms appear to us to be of major importance especially in regard to prognosis.

Ocular symptoms and signs including blepharitis, purulent conjunctivitis, keratitis, optic neuritis, ciliary hyperæmia, nystagmus, ptosis, strabismus, and consequent diplopia.

Our observations have led us to regard these conditions as very ominous in considering prognosis. Many of the cases showed injection of very irregular distribution in the ciliary ring of vessels apart from any associated conjunctivitis or keratitis.

Loss of Control of Sphincters.—Incontinence, especially if prolonged, is a grave symptom. The patients often have a transient incontinence which is of little importance, but we find that prolonged incontinence is only too frequently associated with a hydrocephalic condition, in our experience invariably fatal.

Retention of urine has been the exception rather than the rule in our cases.

Complications and Sequelæ.

Complications.

(1) *Acute Nephritis.*—We believe that acute nephritis is a complication occurring even more frequently than has hitherto been considered the case. In our experience nine cases in a total of one hundred and sixty-one (that is 5·6 per cent) showed evidence of this complication. The presence of a transient albuminuria, unassociated with the occurrence of cellular elements or casts in a catheterized specimen of urine, is almost invariable in cases of cerebrospinal meningitis, and in the majority of cases no trace of albumin is found at the period of convalescence.

Of those cases which had a typical smoky urine, loaded with

albumin, and containing blood corpuscles and recently formed casts in large numbers (nine in number), four died and all five that recovered still showed a very slight but persistent albuminuria, associated with the presence in the urine of a few hyaline and granular casts, when they were discharged to the base hospital.

Œdema of face and dependent parts only occurred in one of these nine cases. We suggest that these cases of cerebrospinal fever complicated by acute nephritis may be potential cases of subacute or chronic nephritis, and may suffer from these latter forms of renal disease subsequently.

(2) *Otitis Media.*—Seen in one case only.

(3) *Suppurative Arthritis.*—Two cases. In each the knee-joint on one side was the only joint affected. Recovery following repeated aspiration of the joint was practically perfect in each case.

(4) *Broncho-pneumonia* occurred in four of our cases.

(5) *Extreme marasmus* occurred in two cases.

(6) *Peripheral Neuritis.*—Two cases.

(7) *Hydrocephalus.*—Both forms—acute and chronic—occurred very frequently. This condition was found post-mortem in some degree almost invariably in fatal cases.

(8) *Hyperpyrexia.*—Seen on two occasions only, both cases died.

Sequelæ.

(1) *Insanity.*—Feeble-mindedness occurred definitely in two cases only, though the possibility of insanity ensuing in any of the others that left hospital apparently cured must not be overlooked.

(2) *Permanent Strabismus.*—Seen in two cases.

(3) *Permanent Blindness.*—Blindness in one eye occurred in one case.

(4) *Permanent Deafness.*—Noted occasionally, where no sign of otitis media had occurred in the earlier stages of the disease.

(5) The possibility of a subacute or chronic nephritis following an acute attack has already been dealt with in the preceding paragraph.

Special Treatment of the Cases.

The patients were nursed in a large airy ward with many windows, kept wide open whenever the weather was sufficiently good. On approaching convalescence, they were put out for the greater part of the day in the open air on a balcony adjoining the ward, and in a few cases during the summer months patients were allowed to sleep on this balcony during the night.

Treatment by Lumbar Puncture.

Frequent lumbar puncture has been the main line of treatment in all our cases. Every case, except one, in which death occurred before treatment could be undertaken, has been treated by lumbar puncture, as a rule, repeated daily for the first four to five days, and then every second day for about the next week, unless symptoms (particularly severe headache) called for more frequent puncture, or unless the patient had already arrived at a convalescent stage. A few cases became convalescent very quickly—within a week—and in these lumbar puncture was discontinued. In cases of relapse, which were not at all infrequent, lumbar puncture was invariably performed again.

For the purpose of performing the operation a little pure chloroform was almost invariably administered.

At each puncture the cerebrospinal fluid was allowed to run out until all excess of pressure was relieved, the needle being withdrawn only when the fluid was escaping at the rate of about forty to fifty drops per minute.

In a few cases we were unable to relieve the excessive intracranial pressure by lumbar puncture, free communication between the intraventricular system and the subarachnoid space being probably obliterated by purulent exudation.

In addition to lumbar puncture various other modes of treatment were employed, viz. :—

(1) *Living vaccine* prepared by one of us (S. R.) from cerebrospinal fluids obtained by lumbar puncture from our own cases.

(2) *Dead vaccine*, also prepared by S. R. from our own cases.

These vaccines were given subcutaneously.

(3) *Various antimeningococcic sera*, given intrathecally.

In these cases treated by anti-meningococcic sera, after allowing the excess of cerebrospinal fluid to escape, a quantity of serum was injected very slowly by means of a syringe, always using a volume of serum less than the volume of fluid which had escaped. After each introduction of serum the foot of the patient's bed was raised for about six hours to aid the flow of the serum towards the ventricles of the brain.

The volume of serum given at one time varied from twenty to forty cubic centimetres according to the volume of cerebrospinal fluid which escaped. Not more than six doses of a serum were as a rule given to one patient. In those cases which had received six doses and which still called for further treatment,

lumbar puncture was performed as often as deemed necessary, but no further dose of serum given.

The numbers of cases receiving the various kinds of treatment with results are summarized below :—

	Treatment	Cases treated	Recovered	Deaths	Cases still in hospital	Per cent case mortality
	Lumbar puncture only	43	21	21	1	49
Repeated lumbar puncture combined with	Living vaccine	29	16	13	–	45
	Dead vaccine	52	24	28	–	54
	Serum B and W	6	1	5	–	83
	Serum Flexner	16	6	9	1	56
	Serum Pasteur	11	4	7	–	64
	Serum Mulford	3	2	–	1	– –
	Untreated	1	–	1	–	– –
	Total	161	74	84	3	

Total cases treated, 161 ; died, 84 ; per cent case mortality, 52.

We think it only fair to ourselves to point out here that several cases (five in number) clinically very suggestive of a mild form of cerebrospinal fever, but which were never proved by us to be such, examinations of the cerebrospinal fluid proving negative, are not included in the above table. These cases invariably recovered, and although in all probability they were true examples of cerebrospinal fever, the absence of absolute proof of their identity has caused us to omit them in considering results of treatment.

We feel also that our high percentage case mortality is in some measure due to the fact that many of the cases came to us untreated as far on in the disease as the fifth to sixth day from date of onset—a few even as late as the ninth to tenth day. Had these cases come under treatment earlier, no doubt the percentage case mortality could have been considerably reduced. In no less than twelve instances the cases admitted were of the fulminant variety and were hopeless from the very first.

It will be gathered from the above figures that no one method of treatment employed gave results sufficiently good to enable us to infer that that particular method carried with it any great possibility of recovery, although the series treated by living vaccine together with repeated lumbar puncture has a percentage case mortality four lower than the series treated by lumbar puncture alone. It is to this series of twenty-nine cases treated by repeated lumbar puncture combined with living vaccine that we would draw particular attention.

Post-mortem Examinations.

These were performed in about fifty cases. No special features were discovered that had not been previously described.

In addition to the lines of treatment already mentioned, operative procedures were undertaken in five of the cases; details of these appear below :—

Cases.

Five Cases submitted to Operative Procedure.

Case 16.—Private C., aged 17. Admitted to hospital February 11, 1915. Then ill three days. Complained of severe occipital headache, vomiting and pains in the limbs; tongue dirty, appetite poor; drowsy; tendon reflexes all exaggerated; lumbar puncture performed on admission; cerebrospinal fluid found turbid and under increased pressure; microscopical examination of centrifuged deposit showed many pus cells and intracellular diplococci; 10 c.c. of Burroughs Wellcome's serum introduced intrathecally; 500 millions of a dead vaccine (prepared from several strains obtained from our own cases) given subcutaneously. February 13: Some slight improvement; tongue cleaner; appetite better; less pain in the head; lumbar puncture repeated and serum again introduced. February 14: 1,000 millions of vaccine given subcutaneously. February 15: Again slight improvement; less drowsy than previously. February 16: 1,000 millions vaccine. February 17: Not so well. February 18: Violent headache again; lumbar puncture; no serum given; 1,000 millions vaccine subcutaneously; February 19: No marked change. February 20 to March 6: Patient gradually losing ground; frequent headache with no relief from hypnotics and sedatives; mentally very dull and stupid; fundi examined; commencing optic neuritis; during this period lumbar puncture performed without much relief on five occasions and seven doses of vaccine given. March 7: Operation decided upon; in left temporo-frontal region.

Decompression.—A large scalp flap turned down, and a disc of bone trephined over the left Rolandic area. Opening in skull enlarged a little in all directions; no very marked bulging of dura found; pulsation of the brain good; dura not opened; scalp wound closed. March 8: Patient had a quiet night following operation; headache slightly better. March 9: Given a dose of vaccine subcutaneously. March 10: Still some headache; patient drowsy; taking food fairly well. March 16: Patient brighter; taking interest in his surroundings; speech hesitant and slow; no pain;

temperature normal for the first time. March 20: Fundi examined again—right optic disc still indistinct; vessels partly obscured and apparent bending over at the edge of disc. Left optic disc—outer edge partially clear; rest of edge blurred; inner edge clear; vessels partially obscured. March 23: Progress good; mentally bright and rational; speech clear. March 24: Fundi examined; right disc very much clearer; left disc as before. March 25: Progress satisfactory; no headache; transferred to base hospital; convalescent.

Case 53.—Lance-Corporal D., aged 20. Admitted to hospital March 7, 1915. Appeared to be a case of moderate severity; ill several days before admission; diagnosed by examination of cerebrospinal fluid on day of admission; Flexner's serum introduced intrathecally. March 8: Lumbar puncture repeated; serum given again. March 9: Shows slight improvement. March 10: Lumbar puncture again; serum given. March 11: Lumbar puncture again; serum given. March 13: Violent headache again; lumbar puncture; serum introduced; cerebrospinal fluid still under much pressure. March 14: Not so well; head retracted; headache persists. March 15: Transient diplopia; unequal pupils; lumbar puncture; serum given. March 17: Patient has developed a facial erysipelas beginning in a small septic spot on the left cheek. March 18: Lumbar puncture; serum given; mentally inaccurate; delirious. March 20: Erysipelas has spread over nose to the right cheek; incontinent. March 21: Lumbar puncture; serum given. March 23: Extreme head retraction; semi-conscious; erysipelas has subsided. March 25: No improvement; lumbar puncture; no serum given; cerebrospinal fluid shows no increase of pressure; taking food very badly; commencing bedsores. March 27: Quite comatose; purulent conjunctivitis; fundi examined; optic neuritis present.

March 28: *Operation.—Decompression.* A large area of bone removed in the left temporo-parietal region; dura not bulging unduly; pulsation of brain good; wound closed. Patient after leaving the theatre and despite stimulants died nine hours later.

Post-mortem.—A generalized meningitis, with a hydrocephalic condition was found; ventricles hugely distended with turbid fluid and convolutions flattened.

Case 66.—Lance-Corporal C., aged 23. Admitted to hospital March 20, 1915: Then ill five or six days; violent occipital headache; vomiting; pain in the back, neck and limbs; head retracted; reflexes brisk; Kernig's sign marked; mentally dull and drowsy;

lumbar puncture performed; cerebrospinal fluid very turbid; high pressure; bacteriologically positive as regards meningococcus; dead vaccine 500 millions given subcutaneously. March 21: Lumbar puncture performed. March 22: Living vaccine 200 millions given subcutaneously (this vaccine also prepared from cerebrospinal fluid of our own cases). March 23: Semi-conscious; taking food badly; incontinent; paralysis of left face; paralysis of left external rectus; left cornea clouded (iritis present). March 25: Lumbar puncture performed again; 500 millions living vaccine given; tongue now deviated to right side on protrusion. March 28: 500 millions living vaccine given. March 31 to April 19: No improvement; marked loss of flesh, mentally extremely dull and apathetic; during this period lumbar puncture on four occasions and two further doses of living vaccine given.

April 21: *Operation.*—Decompression over the right frontal lobe; incision of dura and puncture of the anterior horn of the right lateral ventricle; dura found very tense, no visible pulsation and even when dura had been incised pulsation of brain very feeble; brain bulging up into the wound: on puncture of the ventricle a slightly opalescent fluid escaped; about 5 drachms removed; brain pulsation now more distinct; we had intended introducing into the ventricle at this stage 10 c.c. of Pasteur's antimeningococcic serum, but after about 5 c.c. had been put in patient strained and began to vomit (anæsthesia, open ether and very light). Patient showed signs of collapse; it became necessary to close quickly; dura being left open. Patient died the same day at 7 p.m., nine hours after operation.

Post-mortem.—A condition of chronic hydrocephalus was found; anterior horn of right ventricle very much enlarged but collapsed; posterior horn of right ventricle distended with fluid, likewise the left lateral ventricle and third and fourth ventricles; pineal gland enlarged and cystic; choroid plexuses pale and atrophied.

Case 102.—Second Lieutenant M., aged 24. Admitted to hospital April 18, 1915. Then ill five days. A typical case of severe type; mentally confused; slight head retraction; purpuric rash; violent headache; lumbar puncture had been performed once before admission; cerebrospinal fluid found bacteriologically positive. For the next six days lumbar puncture repeated and Pasteur's serum given intrathecally each day. Progress seemed to be fairly good; patient became brighter, mentally clearer and had less pain; there was occasional incontinence. May 25: Patient losing ground rapidly; very drowsy, stupid and frequently delirious; lumbar puncture again and serum given. No improvement.

May 26: *Operation.*—A large sub-temporal decompression performed. Dura left unopened; no undue bulging of latter and pulsation of brain good; scalp wound closed. Patient left the theatre fairly fit and not showing any signs of collapse. Patient lived for ten days after operation but went slowly downhill and died comatose.

Post-mortem.—A generalized meningitis, with purulent exudation chiefly marked at the base of the brain. A marked hydrocephalic condition also present.

Case 69.—Private M., aged 21. Admitted to hospital March 22. Severe case, hardly conscious on admission, who improved somewhat under treatment by repeated lumbar puncture and living vaccine for a week. Between March 22 and March 28 lumbar puncture was performed and vaccine given as follows:—

Date	Living vaccine	Lumbar puncture
March 22, 1915	200 millions	Performed.
„ 23, 1915 } „ 24, 1915 }	—	No special treatment.
„ 25, 1915	500 millions	Performed.
„ 26, 1915 } „ 27, 1915 }	—	No special treatment.
„ 28, 1915	500 millions	Performed.

During the next two days patient was very dull and apathetic. Some delirium; incontinent. Marked left-sided facial paralysis.

March 30: *Operation. Lavage of Spinal Theca.*—Patient anæsthetized (chloroform). Lumbar puncture needle introduced through spinal theca into sub-dural space between the second and third lumbar vertebræ; patient lying on left side and curled up. About 15 c.c. of turbid cerebrospinal fluid escaped. About 40 c.c. of sterile normal saline at normal body temperature (37° C.) were introduced through the needle into the spinal theca by means of a sterilized rubber tube and funnel, at a water pressure of four and a half inches. This accomplished, a second lumbar puncture needle was introduced into the sub-dural space between the seventh cervical and first dorsal vertebræ. Turbid fluid immediately escaped under considerable pressure from the upper needle. A sample of this fluid was taken in a test-tube. Next, about 40 c.c. of saline were run in from below, and the excess allowed to flow out from the upper needle, thus irrigating a large part of the spinal sub-dural space. Two further samples of fluid were taken from the upper needle.

Examination of the Samples of Fluid Escaping.—(1) From the lower needle at commencement of operation; very turbid. (2) (3) and (4) From the upper needle, showed a definite gradual decrease

in turbidity, and also in height of coloration; the first sample being greenish yellow in hue, the last just milky and opalescent. A microscopical preparation of each sample showed a corresponding decrease in the number of polymorphonuclear leucocytes present in the fluid.

This operation was not followed by any distinct improvement.

March 31 to April 29: Between these two dates lumbar puncture was performed twice and two further doses of living vaccine were administered. Patient became extremely emaciated and died comatose on April 29.

Two Cases of exceptionally long duration with Recovery.

Case 101.—Private E., aged 22. Admitted to hospital April 14. A typical case of moderate severity. Complained of violent occipital headache, pain at the back of the neck and down the spine; vomiting. A generally distributed rash—partly petechial and partly urticarial in character—but particularly marked on extensor aspect of forearms, hands, legs and feet. Lumbar puncture performed on admission; cerebrospinal fluid very turbid, under high pressure. Centrifuged deposit shows many polymorphonuclear leucocytes with typical intracellular diplococci—also a marked lymphocytosis —large and small mononuclears being present. Pasteur's serum introduced intrathecally. April 15 to April 20: Daily lumbar puncture and Pasteur's serum introduced intrathecally. April 27: Patient had progressed fairly satisfactorily and was transferred to a convalescent ward. He had lost a considerable amount of flesh and had had recurrent urticarial eruptions. He was mentally clear and rational. May 13: Not so well. Irregular pyrexia, anorrhexia, and vomiting. The latter was sudden, copious and unaccompanied by nausea or abdominal pain. He also complained of occasional severe headache. There was no ocular or facial paralysis. Movements of head and limbs, however, were tremulous. Remains mentally rational. Lumbar puncture without introduction of serum was followed on May 14 by marked improvement. The cerebrospinal fluid was slightly turbid, under increased pressure. Microscopical examination of centrifuged deposit showing cells only. Irregular pyrexia with headache and vomiting however recurred, and on May 21 and May 23 lumbar puncture was again performed. May 25: Patient had a severe rigor. May 26: Another rigor; vomiting continues. May 29: Patient now shows double foot-drop; is extremely emaciated; pyrexia as before; pulse rapid and feeble at times. He continues to take a fluid diet well, and though querulous, his mind remains clear. He complains of tingling

and numbness, and also of muscular tenderness in the calves of the legs. There has been no interference with the action of the sphincters. June 21: Massage has relieved pain in legs. He is much brighter mentally, and is taking more food. Irregular pyrexia however persists. Still occasional headache and vomiting as before. July 15: No noticeable change. July 21: Temperature now remains down; generally improved; still occasional pain in the feet and in the muscles of the abdominal wall. August 11: Progress continues to be satisfactory, and to-day patient was transferred to Base Hospital. September 15: Patient was able to walk a few steps for the first time, aided by crutches. October 16: Patient can now walk a short distance unassisted. His mental condition is satisfactory. Duration of pyrexia, ninety-six days.

Case 141.—Driver M., R.F.A., aged 22. Admitted to hospital June 12—then ill six days. Lumbar puncture had been performed at a casualty clearing station before admission and the meningococcus found. On admission here semi-conscious; head retracted; neck and limbs very stiff; Kernig's sign present; reflexes natural; photophobia; tache cérébrale present. Patient very irritable and difficult to examine. Respirations rapid and laboured; slightly cyanosed; incontinent. Lumbar puncture performed; cerebrospinal fluid found very turbid; no increase of pressure. Microscopical examination of centrifuged deposit shows many polymorphonuclear leucocytes; lymphocytes of both varieties, large and small, and a few typical intracellular diplococci. Flexner's serum introduced intrathecally. June 13: Much clearer mentally. No head retraction; no cyanosis; respirations quiet and slow. Gives an accurate history of illness. Lumbar puncture again performed and Flexner's serum given intrathecally. To-day pressure of cerebrospinal fluid considerably increased. June 14: Lumbar puncture repeated and serum again introduced. June 16: Incontinent; mentally dull; slight purulent conjunctivitis; herpes labialis. Does not complain. Lumbar puncture performed without introduction of serum. June 19 to July 18: Patient gradually lost ground. Mentally always uncertain; taking food badly; incontinence of urine and fæces; frequently delirious. Slight head retraction; very tremulous; marked loss of flesh. Lumbar puncture performed on three occasions. July 18 to August 19: No marked change. Bedsores; taking food slightly better; purulent conjunctivitis; extremely emaciated. Lumbar puncture not performed during this period. August 19 to September 18: Patient's condition now very variable, some days a little brighter and taking food well; other days drowsy,

dull and extremely difficult to feed. Incontinence as before. No sign of gaining flesh ; marasmus is now even more marked than previously. Lumbar puncture performed on two occasions. Cerebrospinal fluid very slightly turbid ; pressure slightly increased. September 24 : Wildly delirious—screaming and shouting ; hypodermics of morphia and hyoscin being necessary. September 26 : Dull and drowsy again ; has a marked iritis of the right eye. Lumbar puncture performed. Cerebrospinal fluid shows no increase of pressure. Incontinence persists. Temperature now remains subnormal for the first time. October 11 : Patient now remains well ; brighter and clearer mentally. Bedsores healing. No incontinence ; talking better. October 20 : Progress satisfactory ; gaining flesh and strength. Mentally quite clear and rational ; memory fairly good. Duration of pyrexia, one hundred and forty-one days.

Four Cases of Etat méningitique or " Simple Meningitis."

These cases are examples of a condition in which the physical signs and symptoms suggest a mild case of cerebrospinal meningitis, but in which no bacteriological proof of the presence of the meningococcus has been obtained. The cerebrospinal fluid in this condition shows a marked lymphocytosis only, no polymorphonuclear leucocytes being found. All the cases are said to recover.

Case 1.—Private N., aged 26. Admitted to hospital April 1, having been ill two days with headache, vomiting, pains in the back and limbs. Onset sudden. On admission, mentally clear and rational. Tongue furred but moist. Temperature 99·6° ; pulse 60, full. Slight stiffness of neck ; marked photophobia ; reflexes very active ; knee-jerks exaggerated ; Kernig's sign doubtfully positive. Lumbar puncture performed, cerebrospinal fluid very slightly turbid ; very high pressure. Microscopical examination of cerebrospinal fluid shows very marked lymphocytosis ; no polymorph leucocytes or organisms found. Given 500 millions dead vaccine subcutaneously. Culture of fluid in blood-broth sterile at end of forty-eight hours. Blood culture—in broth—reported sterile at the end of seventy-two hours. April 2 : Patient had a restless night ; headache and vomiting ; photophobia and stiffness of neck still marked ; splenic dullness increased ; spleen not palpable ; knee-jerks brisk. Lumbar puncture repeated ; cerebrospinal fluid as before, slightly turbid under high pressure. Shows lymphocytes only. Fundi examined—discs clear. Patient made an uneventful recovery and was perfectly well within ten days of onset of symptoms.

Case 2.—Corporal P., aged 30. Admitted to hospital April 23. Taken ill on April 19; slight headache; vomiting; general aching of the body and limbs; feverish. He had had a sharp feverish attack a few days before this, and thought this present attack was a recurrence of the same, but symptoms were getting more severe. On admission to hospital, rational; still headache and vomiting; tongue furred but moist; neck stiff and legs very stiff; Kernig's sign present; knee-jerks absent; patellar reflexes flexor. Temperature 101° F.; pulse 88 full. Lumbar puncture performed. Cerebrospinal fluid slightly turbid and under increased pressure. Microscopical examination of fluid showed marked lymphocytosis. No polymorph leucocytes or organisms found. Culture of fluid proved sterile. Blood culture also proved sterile. White blood cell count, 11,000. April 25: Patient much better; no headache or vomiting. April 27: Temperature normal; feels perfectly well. May 3: Tranferred to base hospital. Convalescent.

Case 3.—Private N., aged 24. Admitted to hospital April 20, 1915. Ill four days, headache, constipation; on admission mentally dull and drowsy; no accurate account of his illness was obtainable from the patient; tongue very dirty; pharynx injected; slight photophobia; temperature 99° F.; pulse 100; knee-jerks absent; Kernig's sign present; lumbar puncture had been performed at a clearing station before admission here; cerebrospinal fluid reported opalescent, containing lymphocytes only; 20 c.c. Flexner's serum had been given intrathecally. On admission to our hospital lumbar puncture repeated; cerebrospinal fluid turbid and under high pressure, shows lymphocytes only, no organisms found; 30 c.c. Pasteur's serum given intrathecally. April 21: White blood cell count, 20,000; still much headache; vomiting again; lumbar puncture; cerebrospinal fluid slightly turbid and under high pressure; microscopical examination as before; culture of cerebrospinal fluid proved sterile; blood culture proved sterile. April 23: No marked change in patient's condition; lumbar puncture; cerebrospinal fluid as before; second culture of fluid proved sterile. April 24: Lumbar puncture; cerebrospinal fluid practically clear; pressure slightly increased; third culture of fluid proved sterile. April 25: Patient now progressing favourably. May 1: Temperature has now fallen to normal. May 3: Complete recovery; sent to base convalescent.

Case 4.—Private W., aged 17. Admitted to hospital April 8, 1915. Had then been ill three days, headache, pain in the neck and lumbar region, stiffness of the neck. Onset sudden. Lumbar puncture had been performed twice at an isolation hospital

before admission. April 6: Cerebrospinal fluid found clear, but under very high pressure; no cells or organisms found in the fluid; culture of the fluid proved sterile. April 7: Pain in head and back worse; stiffness of the neck more marked; temperature 99° F.; vomited several times to-day. April 8: Lumbar puncture repeated; cerebrospinal fluid again quite clear, but now shows very distinct lymphocytosis; no polymorphs or organisms found; white blood cell count, 14,900.

On admission to our hospital, conscious, but very drowsy; dull and apathetic; still complains of headache, stiffness and pain at the back of the neck; has very slight head retraction; tongue furred and dry; temperature 100° F.; pulse 70; knee-jerks exaggerated; Kernig's sign present. Given 500 millions dead vaccine subcutaneously. April 9: Much better to-day; no stiffness of the neck; Kernig's sign absent; knee-jerks natural; no headache; tongue clean; temperature normal. Patient remained perfectly well from this date.

A Case clinically identical with Cerebrospinal Fever, but not proved to be such bacteriologically.

Second Airman B., aged 21. Admitted to hospital May 28. Then ill three days with headache, vomiting, pain in the abdomen, shivering. He was mentally rational, but memory a little hazy and uncertain; headache now very violent and worse in the occipital region; there was slight stiffness and pain in the back of the neck; slight abdominal pain and rigidity; there was a generally distributed rash, partly purpuric and partly petechial in character. He had peculiar blotchy conjunctival congestion, and also slight hyperæmia of the ciliary vessels; pupils were equal, and reacted to light and accommodation; slight photophobia; pharyngeal wall injected; tongue furred and dry; marked hyperæsthesia; tache cérébrale present; knee-jerks exaggerated; Kernig's sign absent; patellar reflexes flexor; temperature subnormal; pulse 96. Lumbar puncture performed; cerebrospinal fluid quite clear, but under very high pressure. Fluid contains an excess of albumin, and a few lymphocyte cells were seen in a centrifuged deposit. Culture of fluid proved sterile. Urine examined (catheter specimen); smoky; reaction to litmus, acid; a dense cloud of albumin; no sugar. Centrifuged deposit shows blood cells, and many blood and recently formed epithelial casts. White blood cell count, 60,000; blood culture proved sterile. May 29: Patient dull and quiet; still has headache; no head retraction; marked herpes on lips, chin and nose; Kernig's sign present; has a purulent conjunctivitis; rash

is more marked to-day, especially on the extensor aspects of limbs. Lumbar puncture repeated; cerebrospinal fluid clear, still under very high pressure, contains a few lymphocytes only; culture of fluid again proved sterile. Temperature chart shows slight pyrexia; pulse slow. May 30: Lumbar puncture; cerebrospinal fluid as before; culture sterile. May 31: Urine, still shows many recent casts and blood cells. A second blood culture taken to-day proves sterile. June 1: Patient much brighter mentally, no pain or headache. June 5: Temperature now remains normal. June 8: Progress satisfactory. June 10: Urine shows a haze of albumin and granular casts. June 16: Patient convalescent and transferred to base hospital.

Case of Hysteria simulating Meningitis.

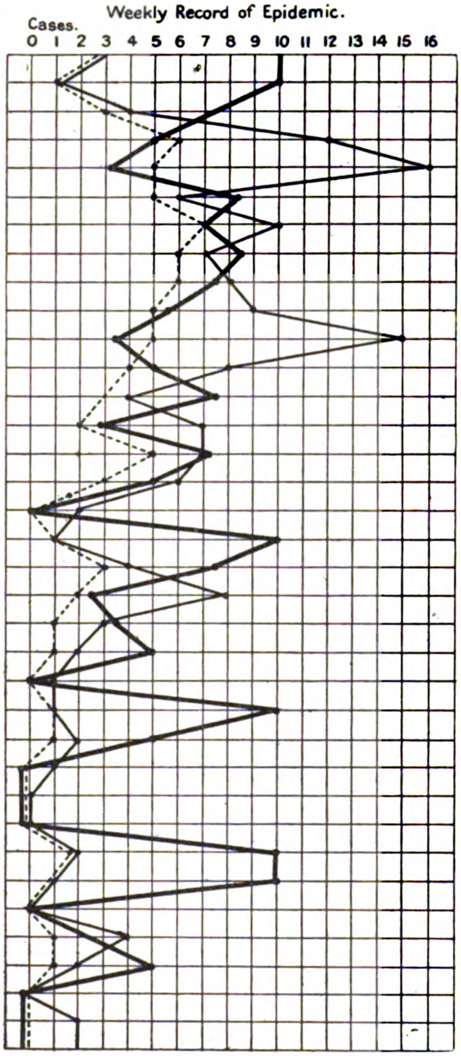
Mrs. M. Patient, a young woman, who had been visiting her husband lying ill with cerebrospinal fever in this hospital for the last few weeks. She was known to have been in very close contact with him on the morning of May 26, just previous to an operation being performed on him. After the operation she continued to visit him, and was perfectly well, to all outward appearances, in every respect, at midday on May 28, 1915.

About midnight (May 28) she was brought to hospital with a history of having been suddenly seized that evening, while walking in the street, with violent headache and inability to stand upright. She fell and sustained severe bruising of the right side of the forehead and slight bruising over the outer side of the right thigh. Shortly afterwards she vomited several times.

On admission patient was mentally confused. Complained of violent occipital headache, pain in the neck and back. Slight stiffness of the neck and slight abdominal rigidity present. Marked hyperæsthesia and photophobia. Patient very restless, throwing herself about the bed as if in great pain. Temperature 101°, pulse 68. Vomiting continues. Lumbar puncture was performed under chloroform. Cerebrospinal fluid found quite clear—no increase of pressure. No excess of cells in a centrifuged specimen. At 10 a.m. next morning—still much headache; has vomited again; slight head retraction; neck stiff; erythematous blotches on the abdomen; tongue very dry and furred; patient conscious but mentally dull; knee-jerks exaggerated (almost knee clonus); ankle clonus present; Kernig's sign doubtful; patellar reflexes flexor. Culture of cerebrospinal fluid proved sterile. Patient was removed this morning to a civil hospital, where symptoms

GRAPHICAL RECORD OF EPIDEMIC, AS IT AFFECTED THIS HOSPITAL.

Weeks	Cases admitted	Deaths among those same cases	% Case mortality	Treatment (i.e., the main line of treatment during each week)
Jan. 17-23	3	3	100	L.P. + Serum.
24-30	1	1	100	L.P. + Serum.
31-6	4	3	75	L.P. + Serum + Vaccine.
Feb. 7-13	12	6	50	L.P. + Vaccine.
14-20	16	5	31	L.P. + Vaccine.
21-27	6	5	83	L.P. + Vaccine.
28-6	10	7	70	L.P. + Vaccine.
Mar. 7-13	7	6	85	L.P. + Flexner's Serum.
14-20	8	6	75	L.P. + Serum + Vaccine.
21-27	9	5	56	L.P. + Living Vaccine.
28-3	15	5	33	L.P. + Living Vaccine.
Apr. 4-10	8	4	50	L.P. + Living & Stock Vaccine.
11-17	4	3	75	L.P. + Pasteur's Serum.
18-24	7	2	29	L.P. + Pasteur's Serum.
25-1	7	5	71	L.P. only.
May 2-8	6	3	50	L.P. only.
9-15	2	0	0	L.P. only.
16-22	1	1	100	L.P. only.
23-29	4	3	75	L.P. only.
30-5	8	2	25	L.P. + Flexner's Serum.
June 6-12	3	1	33	L.P. + Flexner's Serum.
13-19	2	1	50	L.P. + Flexner's Serum.
20-26	1	0	0	L.P. only.
27-3	1	1	100	L.P. only.
July 4-10	2	1	50	L.P. only.
11-17	1	0	0	L.P. only.
18-24	0	0	0	—
25-31	0	0	0	—
Aug. 1-7	2	2	100	L.P. only.
8-14	1	1	100	L.P. only.
15-21	0	0	0	—
22-28	4	1	25	L.P. only.
29-4	2	1	50	L.P. only.
Sept. 5-11	0	0	0	—
12-18	2	0	0	L.P. only.
19-25	2	0	0	L.P. + Mulford Serum.



Total cases	161	Case incidence shown thus	————
Deaths	84	Deaths occurring among those same cases	- - - - - - - -
% Case mortality	52	Percentage case mortality	▬▬▬▬

described above persisted for some days, and lumbar puncture was repeated on two further occasions, but the fluid was found clear and quite normal each time. Recovery was rapid, patient becoming quite rational in every way within a week.

We heard later that the patient after leaving France suffered with sciatica, which at first she feared might be meningitis. The entire absence of any evidence derived from examinations of the cerebrospinal fluid suggestive of meningeal infection, together with the history of this case and rapid recovery have led us to believe that the illness was entirely of a functional nature.

The bacteriology of the meningococcus is notoriously difficult. This arises from the difficulty in growing the organism. Growth can often be obtained from an obviously infected fluid on blood agar; in many cases, however, no growth is obtained on this medium. Blood broth on the other hand never failed to give a growth from an obviously infected fluid. Blood broth (prepared by adding fresh blood to broth with a little citrate), however, suffers from the disadvantage common to all liquid media.

The identification of the organism is also, especially in the case of throat and nasal infections, often very problematical. No differential medium or method of isolation, such as we have in the case of the enteric group of organisms, has yet been devised. This fact must always be borne in mind in considering the application of any series of observations on the presence of the meningococcus in the naso-pharynx. Consequently the whole question of the significance of carriers in this disease despite the enormous amount of work that has been done, should still be regarded as *sub judice*.

Concluding, we wish to record our most grateful thanks to Colonel Sir Wilmot Herringham, Consulting Physician to the British Expeditionary Force, for his kindness and interest in superintending our work all through, especially with regard to the employment and dosage of the sera and vaccines used in the treatment of the cases.

THE TREATMENT OF JAW INJURIES.

BY

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Of all the many and varied "war" injuries which men fortunately survive, few are more distressing for the victims than those which result in some permanent deformity of the face.

The sight of an artificial leg or an empty sleeve excites feelings that combine pity with admiration. A face that has been rendered hideous by a gunshot wound rouses our pity alone, a fact of which the sufferer is ever conscious.

In a large number of cases, wounds of the face are accompanied by extensive lesions of the jaws, particularly of the mandible. Such injuries differ from those ordinarily met with in civil practice in that it not infrequently happens that the bone, to a greater or lesser extent, has been entirely destroyed or shot away. Unless such an injury is efficiently treated, not only is the external deformity greatly increased, but the patient is left with a mandible utterly incapable of performing its normal function. The patient's future life is blighted, and his economic value to the State greatly reduced, for his chance of employment will be in inverse ratio to the degree of his disfigurement.

Claude Martin, of Lyons, was the first man to devise a scientific method of dealing with these cases, and it is to him that we owe most of our knowledge of the subject. His methods hereafter described can only be carried out by someone who is thoroughly conversant with the construction and fitting of mechanical appliances, and for this reason the assistance of the dental surgeon is essential in the treatment of these conditions.

There are, unfortunately, still many surgeons who do not appreciate how much can be done to restore function and to improve the disfigurement, if treatment is undertaken in time. When large portions of the jaws are destroyed by bullets or shell splinters, the resulting cicatricial contraction of the soft parts very soon produces considerable displacement of the remaining parts, and treatment, to be successful, should be undertaken as soon as possible after receipt of the injury.

Since the commencement of this War, the French have segregated these cases in certain definite centres, notably at Paris, Lyons and Bordeaux, where they are systematically treated by special staffs of dental surgeons selected for this purpose. With a view to studying their methods, the authors went to Paris in August of this year, and visited a number of hospitals where this work is carried on.

Among the various hospitals visited, the following four were specially equipped for the treatment of jaw injuries, namely, the Val de Grâce, Ecole Dentaire, No. 39 Auxiliary Hospital of the Croix Rouge, and the American Ambulance at Neuilly. The results seen at these institutions were such as to convince the most sceptical of the benefit of Claude Martin's methods, on which, as has already been stated, the whole of the present treatment is based.

Many of the cases seen presented the most frightful appearance on admission. A very common form of injury was the almost complete destruction of the body of the mandible, leaving only the rami and a small portion anterior to the angle bearing two or three teeth on each side. Owing to muscular contraction these remaining portions were drawn in across the floor of the mouth out of all relation to the upper arch, and the lacerated soft parts of the chin and lip had retracted back level with the centre of the palate, leaving the tongue protruding. The power of speech was almost or quite destroyed; eating was impossible, and fluid foods could only be swallowed with great difficulty; while the escaping saliva flowed in a constant stream down the neck, soaking the clothes. Such cases after treatment could scarcely be recognized. The power of speech was completely restored; the flow of saliva had ceased; and the chin and general facial contours were almost entirely re-established. The power of mastication was restored in proportion to the degree of muscular power available.

The principles of treatment are simple, and are divided into three stages, which must always follow one another in a definite order. They are as follows:—

(1) Reduction of the displacement and maintenance of the remaining fragments during healing of the parts.

(2) Stretching of the cicatricial tissue and the remoulding of the facial contours.

(3) Fitting of a permanent prosthetic appliance to replace lost parts, restore function, and preserve the facial outlines.

(1) *Reduction of the Displacement and Fixation of the Bony Fragments.*—This can be accomplished in several ways. When the

injury is quite recent, and the parts are not bound down by cicatricial bands, it may be possible to press them back into position with the fingers. When, however, as is most often the case, they cannot be so replaced, some form of expanding splint is required. A useful appliance for this purpose is made by casting metal cappings to the remaining teeth of each fragment, and uniting the cappings of the two sides by an expanding spring or screw. The occlusal surfaces of the cappings are removed to allow of correct

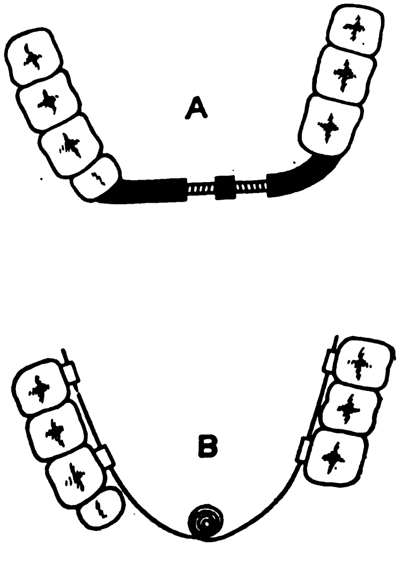

Fig. 1.

interdental articulation. The splint is cemented to the teeth and left in situ, until the fragments are pressed outwards into their correct positions (fig. 1, A and B). A permanent splint is then substituted for the above, and is made by capping the teeth as before, but in place of the spring or screw a solid bar of metal is soldered between the cappings of the two sides. This bar is curved to follow the normal arch of the jaw as far as possible. The splint is firmly cemented to the teeth, and is made rigid and very strong, so that mastication can be carried on by its aid (fig. 2).

It is not possible in a short paper to describe the many different appliances which are designed to treat the great variety of injuries

that present themselves, and two other examples will suffice to explain the methods involved.

In cases where the foregoing method is not suitable, *inter-maxillary* pressure may usefully be employed. This is effected by capping the teeth of the displaced fragments with metal, to which are soldered small metal hooks. The teeth of the opposing jaw on the same side are similarly capped and provided with hooks. Traction in the desired direction can then be exerted by means of elastic bands between the upper and lower hooks (fig. 3).

FIG. 2.

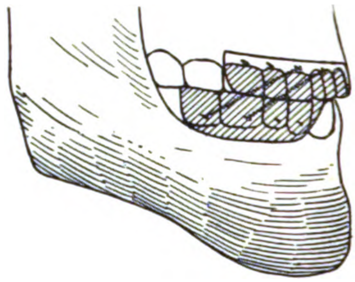

FIG. 3.

Finally, when one entire side of the mandible has been destroyed, and the remaining half has been drawn across to the injured side, as is always the case with such injuries, pressure must be applied by means of a head cap. A metal band is fitted round the head above the ears, to which is soldered a metal bar running down the line of the ramus on the sound side, to the angle of the mouth, where it terminates in a loop. A cast metal capping is cemented to the teeth of the remaining fragment, from which a short metal bar, also terminating in a loop, protrudes between the lips. Elastic traction is then exerted between the two loops (fig. 4).

By this means the remaining half of the mandible is drawn back to its normal position. To maintain it there a thin vertical plate of metal is fixed on the outside of the mandible, and a similar plate to the maxilla on the same side, which engages the inner surface of the lower plate in such a way that the plates or slides remain in contact, whatever the position of the jaws (fig. 5).

An important point which it is desired to emphasize here is that these appliances, which must necessarily be fixed while the wound is still septic, far from increasing the sepsis, as has been alleged, tend to diminish it and promote healing, owing to the rest and support thus afforded to the lacerated parts.

(2) *Stretching of the Cicatricial Tissue and Remoulding of the Facial Contours.*—This stage of treatment is based upon the fact that newly formed cicatricial tissue has an almost infinite capacity for expansion, and, containing but few elastic fibres, it has but little contractile power after being stretched. A curved vulcanite bar is made to rest upon the floor of the mouth in front of the metal bar,

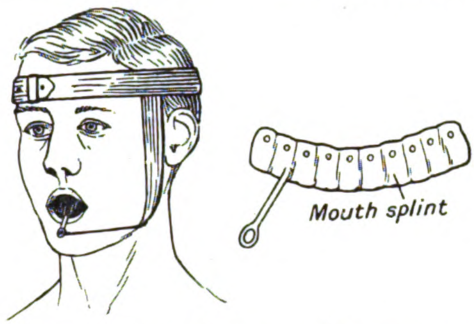

FIG. 4. (After Martinier and Lemerle.)

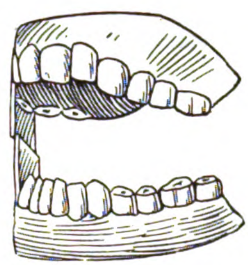

FIG. 5. (After Martinier and Lemerle.)

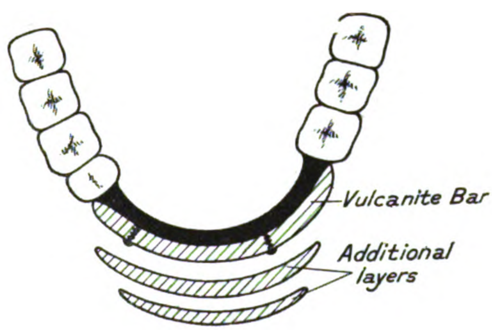

FIG. 6.

to which it is fixed by means of removable screws. Thin plates of vulcanite or hard rubber are gradually added to the anterior surface of this vulcanite bar, so as to press upon the cicatricial tissue and form a sulcus in which an artificial jaw can finally rest. By the same process, the soft tissues are gradually pressed outwards in the labial and mental regions until the normal outlines of the lip and chin are restored as nearly as possible (fig. 6).

Skin-grafting may be necessary in cases where there is extensive loss of the soft parts or loss of the lips.

(3) *The Permanent Prosthetic Appliance.*—An artificial jaw in vulcanite is carefully constructed to a model of the restored mouth.

It is attached to the metal bar, as in the case of the previous appliance, and rests in the groove in the soft tissues which has been prepared for it. It is of sufficient thickness to keep the lip and chin pressed out to the position already gained, and is furnished with teeth which articulate accurately with those of the upper jaw. The patient can remove the jaw for cleansing purposes by undoing the screws attaching it to the metal bar. If desirable, the vulcanite jaw can be fixed directly to the teeth by means of clasps, and can be removed like a denture (fig. 7).

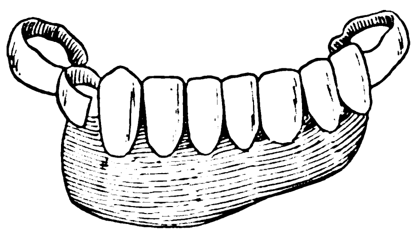

FIG. 7.

With regard to wiring of the fragments, this is rendered unnecessary, and even undesirable in the majority of cases, since in cases of fracture without loss of bone the splint is more scientific and hygienic ; and in those cases where part of the arch is destroyed, wiring the remaining fragments together perpetuates the deformity which it is the object of the treatment to remedy.

We have given this very brief résumé of the system of treatment with a view to drawing the attention of surgeons generally to its possibilities, and we are sure that a twenty-four hours' visit to Paris would speedily convince anyone of its efficacy. It is, unfortunately, true that many of these cases in England at the present time receive little treatment towards restoration of function and correction of deformity in their early stages. After several months they frequently drift into the hands of dental surgeons in civil hospital and private practice, who are asked to undertake the restoration of the jaws when it is too late to obtain satisfactory results. Deformities have become firmly established, which might have been prevented or corrected by the application of interdental appliances at the commencement of the treatment. The minimizing of such deformities and the prevention of impaired function depend upon the immediate co-operation of surgeons and of dental surgeons possessed of the skill and experience in the treatment of injuries of the jaws such as general hospital practice alone affords.

SOME MUSINGS OF AN IDLE MAN.

By Colonel R. H. FIRTH.

I.

Arma virumque cano: thus Virgil began his great epic. I have no intention of trying to imitate the great Latin poet, but certain recent incidents have suggested a train of thought which may suggest others to the reader. A few days ago I was watching the practice of a howitzer battery against a certain hostile position in France, when a distant farm building collapsed suddenly from a single shell. As one stood and observed the evident upheaval produced some miles away by the gunner, one could not help thinking how much the distant cataclysm evoked by the man, who fired the piece, transcended his own muscles, perceptions, and emotions. Clearly, the human had passed from being a man to being a mechanism, and become a non-sentient agent of destruction. Here, close to one, was a colossal killing power which, had it been developed inside, and not outside, the human organism, predicated a being proportionately huge in bulk, in feeling, and in brain. Not even the great creatures described by Swift in "Gulliver's Travels," and whose swords were forty feet long, would have sufficed to embody a duct that at one discharge could knock a house down and kill a score of men, or scoop a hole large enough for their grave. Yet the man who fired the gun was relatively a mere pigmy, and to all intents and purposes a mere appendix to his own hypertrophied lethal organ.

Clearly the situation is remarkable, and a curious contrast to the days of archers, when the man who dared loose an arrow from a bow-string lived up to the limits of his moral and physical nature. In old days, when man confined himself to simple weapons, fighting remained human and natural. The weapon which does not leave the hand is but an extension of that hand, and the arms and the man are one because our sense of personality extends to the tip of whatever we hold. Even arrows and short range bullets that are effective within a visible range of yards leave a sense of corporeal participation. So also, in cases where the effect was greater than the effort, it was humanly measurable, and the enemy could be seen and hated. However, with the coming of heavy ordnance and the long-range gun, all is changed; the human side of war has vanished largely. Gigantic physical effects are

produced, but the effort made by man leaves no sense of strain proportional to the reality of those effects. My friend the gunner, by an effort no greater than pressing a button, evokes an effect of which the dynamics are many million times greater.

One has referred to Swift's giants, and readers of his well-known book will recall how the Brobdingnagians marvelled at Gulliver having no apparent means of self-defence. They overlooked, or failed to realize, the mental potentiality of the man, yet before man discovered arms he was as poorly off among his fellow-beasts as Gulliver in giantland. If we contemplate natural and naked man, we realize that had he remained in that state he would never have become the lord of creation; that state he obtained by the triumph of brain over brawn, and the hand that first tore off the branch of a tree and used it as a club registered the first step towards grasping the rod of empire. The club begot the spear and the sword, just as the sling and the arrow were harbingers of the fifteen-inch gun, the intermediate period being but an orderly progress through the ballista and the matchlock. A moment's thought makes us realize further that, by weapons thus added to but not a part of his organism, like his teeth and nails, man obtained an immense extension of militant power; moreover, this separation of arms from the man has had far-reaching consequences, in that it has dispensed with evolutionary Time. To evolve a weapon like a spear as an integral part of the organism would be as the evolution of tusks to a boar or an elephant, and demand a million or so of years. But, once that spear is detachable from the organism, it is transmissible to the next and later generations, and man evades the long process of evolution through Time. Not only so, when a weapon of offence or defence is developed naturally as a part of the organism, it bears a proportion to the size or mass of the creature, and is in living relation to the wielder. An artificial weapon has no necessary proportion to the user, and, being indefinitely variable, gives him an infinite range of power.

The irony of the case lies in the circumstance that Time is not cheated nor Nature unavenged. We have seen the gunner set in action forces which far transcend his own physical power and the limits of his sensorium, but those same forces surpass equally his endurance. Those of us who have studied Nature know that she is synonymous with perpetual war, but for every creature the forces of Nature to be resisted are constant and familiar. On the other hand, man's war is spasmodic and discontinuous, and, under

modern conditions, an inferno to which man's nervous system is not attuned. Many of us have seen the nervous shock, the mental breakdown and anomalous symptoms resulting from the continued strain of trench life, combined with the deafening roar of great guns and the explosion of their missiles. In this pandemonium the weaker nerve centres break down or fail to function normally, and men revert to a primitive subconsciousness, becoming deaf, dumb, or blind. In his efforts to make modern war, man has created an environment out of all relation to his nervous system. Had we evolved, as an integral part of the organism, our own shelling, bomb-throwing or poison-gas-emitting apparatus, the rest of our organism would have evolved *pari passu*, and our neurones and ganglionic cells would have accommodated themselves in the course of ages to our death-producing organs. In our haste to secure results and our severance of arms from the man, we must admit that we have outreached ourselves and our capabilities to withstand the strain. A certain number of us do possess a nervous stability capable of meeting the tension, but not one of those can be sure of bequeathing that neuronic equilibrium to the next generation.

Then come thoughts as to the ethics of it all. If self-preservation is the first law of Nature, it is difficult to say that combat is immoral. To every creature we must concede the right to secure its food and its mate, and protect its young; and, in so far as its combativeness is conditioned by these needs, the creature is within the moral pale. So long as man relied on his muscles, his teeth and his nails, the ethical situation was simple; but when he supplanted these by artificial weapons, the situation became more complex. The curious point about it all has been the creation of a fighting class of male as distinguished from a numerically greater group of non-combatant males, these latter being quite unfamiliar with tools of war and more or less ignorant of their own natural combative and destructive powers. The natural corollary of this has been a double ethical standard, one code teaching that the nationalization of homicidal methods was a glory, and the other that to kill was murder. The incongruity is not lessened by the fact that the non-fighting element in modern civilization is apt to idealize war and flatter or honour its executants with titles or praise, while the professional soldier values most the civilization of which he is the guardian and defender. Truly, the more one thinks over the situation, the more puzzled one becomes.

II.

Among my minor vices is the inclination to write rhymed verses. Whilst so engaged, the thought has occurred, how curious it is that we can judge our effort's quality without uttering the words aloud. Every reader of good poetry—say that of Keats, Shelley, Swinburne, and Tennyson—knows that by merely reading a printed book of their poems it is possible to become drugged with sound, and yet those sitting around are all unaware of the music being made and heard through one's eyes. So true is this that one can think of written poetry as a kind of imprisoned sound, or as music asleep on paper and waiting, as it were, for the eye to waken it. In making this analogy, I do not refer to mere metrical verse, like the iambics and hexameters of our schoolboy days. I refer really to rhymed poetry, which has ever the clearest and fullest sound. Rhyme may be likened to a voice; it seems actuated by a magic force which catches the living tones of echo and imprisons them on paper. To write rhymed verse means the acquirement of an art that makes plain words sing aloud. Much as one appreciates good metrical verse, one realizes that it is too mathematical and that its best is suggestive of a graph or a time-machine.

To most of us, the memory of Latin verse is associated only with metre and its difficulties of longs and shorts. But here and there one finds among Latin verse a definite playing with vowel sounds and a repetition which gives a pretty jingle suggestive of rhyming. Thus a line comes into memory which runs thus: "Constitit ante oculos candida vacca meos." I think it is to be found in Ovid, but am not sure as I am writing this within the sounds of guns behind Vermelles, and far from my books. A good example of Latin rhyme and clever vowel repetition is the familiar quatrain from Catullus, who wrote:—

> "Dianae sumus in fide'
> Puellae et pueri integri:
> Dianam pueri integri
> Puellaeque canamus."

Similarly, a primitive form of rhyming is to be found in Greek verse; it generally took the form of the ων syllables, which were so grouped as to suggest the booming of a large bell. I cannot quote correctly an example now, but the informed reader who remembers his classics will readily recall lines of the kind, probably from a chorus in the Agamemnon. However, it is not until the Crusade period and days when troubadours roamed the land that true rhymed poetry came into vogue. Possibly its genesis was the

need for a *memoria technica*. Readers who have been to a public school will recall their school-song, and recognize how such a noisy rhyme as the following was an aid to noisy singing :—

> " Triumphales, O sodales,
> Candilenas fundite,
> Absit questus, dies festus
> Fulget, corda tollite."

It so happens that, lately, I have been able to read a good deal of French verse, and nothing has struck me more forcibly than how that language lends itself to rhyming. Of course, our English poets have excelled also in making good jingling verses. Without books it is hard to give examples, but memory suggests the following, from the "Ingoldsby Legends":—

> "This with his chasuble, this with his rosary,
> This with his incense-pot, holding his nose awry."

The chief charm of the kind of verse with which one amuses oneself in making lies in the demand for ingenuity in the use of vocables. A well-set rhymed verse should surely create subtly an expectancy in the mind and then satisfy it fully at the last. Those who appreciate music know it is the same there; one can almost say that the ear looks forward to the coming echo, calculates when it is due and welcomes it when it comes. At the same time, the ear can foretell the coming meaning. Of course, too close a search for rhyme in making verses involves a loss of liberty in word selection, but it often is counterbalanced by a gain in power, and certainly is a stimulus to song. The greatest volume of rich sound is obtained when we use the rhyme of two whole syllables. It is difficult to do, but Tennyson gives many examples, and Hood even went beyond two syllables when he wrote the lines :—

> " One more unfortunate,
> Weary of breath,
> Rashly importunate,
> Gone to her death."

Well used, the power of rhyming gives effects which are often too subtle for analysis, and nowhere do we find it better exemplified than in those musical verses of Keats, Tennyson, Swinburne and Shelley. What can be finer than the following description of a cloud?—

> " I am the daughter of earth and water,
> And the nursling of the sky :
> I pass through the pores of the ocean and shores,
> I change, but I cannot die.

I wield the flail of the lashing hail,
And whiten the green fields under,
And then again I dissolve it in rain,
And laugh as I pass it in thunder."

The professional reader, who delights only in trypanosomes and bacteria, may think me a romantic dreamer, but I trust he will forgive these reflections, if only that they have served to lighten many hours of boredom for an old contributor to these pages, and, perhaps, may encourage others, similarly placed, to try their hands at versification. Innate modesty compels me to refrain from giving readers samples of my own efforts which prompted this musing.

III.

At mess the other evening we were discussing the effects of the War on the people at home; a man remarked that one effect of the War was that there were fewer women now affected with hysterical or fanciful complaints, and he attributed the circumstance to the fact that their pet doctors were better employed elsewhere. Though unable to say whether the statement had or had not any basis of truth behind it, one could not help thinking over the remark, and realizing that, if true, then those ladies were mere parasites on society, and that the fashionable doctors, whom they consult and who apparently report seriously on those ladies' condition, are really parasites upon a parasite, very much as Swift said when he wrote about fleas having lesser fleas upon their backs to bite them. The thought was qualified by another thought, that the existence of the host tends to make the parasite. It was a disagreeable reflection to find passing through one's mind, but it led naturally to others. We recognize that kindness, pity and sympathy are very high attributes, yet they may be abused or even directed into wrong channels until, in the case of many forms of altruism and charity, the host may make or be the means of fostering the parasite, with the inevitable and regrettable consequences.

As biologists, we are familar with that condition of mutual aid between living beings called symbiosis; but we surmise that, if either partner ceases to do his share, then the term symbiosis must be replaced by some other to indicate a wholly different vital relation. That term is "parasitism," and we reserve it for those cases where there is no reciprocity, but rather that one creature strives and the other thrives at its expense. The living world is crowded

with examples of it, and in many cases it is not easy to detect any very disastrous consequences. Adaptation has been achieved, and the giver seems little the worse for what the taker takes. Surely, to leave it at that is to blink the truth and evade the real issue, which is that all parasites degenerate. The fundamental idea of progress, as conditioned by the struggle for existence, involves the principle that to live, or at any rate to live ascendingly, is to strive. That universal law of striving can be broken only at the certain cost of degeneracy. Keep a sound man long enough on crutches and soon his legs will degenerate; introduce pepsin regularly into the stomach after meals, and that organ will soon cease to produce pepsin for itself; feed intellectually a people on short paragraphs or cinemas, and they will be incapable of mentally assimilating anything that requires a little effort for its reception. Assuming, as we must, that parasitism is synonymous with degeneracy, and if degeneracy be disease as meaning an unhealthy state, then all parasitism involves disease. The tapeworm is a parasite and the product of long ages of evolutionary striving, but, as it has made the great refusal and decided to live upon the activities of another creature, it proceeds to discard nearly all its own vital apparatus. It constitutes a fine example of natural selection, where its host is the survival of the fittest and itself the survival of the worst; but the facts suggest that the theory of natural selection is no explanation of the ascent of living beings. In this thought seems to lie an important truth ; parasitism is an ugly fact of the living world because it involves a refusal of the sole condition of ascent. More than this, it is an odious fact because it means that higher forms of life are preyed upon by low forms. The daily routine of our own lives presents an unceasing stream of examples of this in the many types of infective disease which carry off the best among us.

One cannot disguise from oneself that these biological principles and facts are true, and have sociological applications outside the domain of medicine. We think of the low types of humanity which are parasitic on the high types, and we recall types which, in becoming parasitic, become low types. A turn of thought conjures up a view of the parasitic trades, which, though sources of prosperity, really destroy more life than they produce. What of the great toll of infant life associated with the industrial arts, and of the trade which takes invaluable foodstuffs, such as starch and sugar, and then turns them into alcohol ? On the top of this comes the other thought : and what of the consequences of such parasitism to the parasite and the host ? To ask these questions is surely to

answer them, but we must be careful not to allow our ardour to burn too freely. One thinks here of the common error of enthusiasts who would class the servants of a rich and idle man as his parasites. Therein lies a confusion of thought. Economically, they are dependent on him and may be parasitic; but, biologically, his life is maintained by theirs and he is the parasite and they the hosts. Similarly, extremists among the feminine movement declare the domestic housewife as being necessarily a parasite. True, she may be parasitic, as may be the woman who calls her so, but it depends on circumstances. If the domestic woman gives as much as she gets, produces as much as she consumes, or more, she is not a parasite but a symbiotic. Her apparent economic dependence upon the man's purse is as irrelevant to the real nature of the relation as in the other case of the parasitic owner of a full purse to his servant who ministers to his wants. One might descant at length on this topic, but it would lead to matters outside the scope of our JOURNAL. One thing, however, we can affirm, and that is, that the whole trend of social evolution points to there being less room in the future for parasites in the body politic. Alike for the idle or the vicious, and for the altruistic, devoted and gentle, the advice is, be neither a host nor a parasite.

IV.

I was talking the other day to a French farmer, who was explaining to me his system of crop rotation on the land, and how the beetroot took so much out of the soil. He was a well-informed old fellow and we adjourned to his garden, where he became eloquent on flowers. He told me what I did not know before, and that was that plucked mignonette destroys the flowers all around it. He also alluded to the convolvulus and some other bold and showy plants about, which insist upon blooming without rivals. There are, of course, noxious weeds of which the same thing is true. On returning to my billet that evening, I met the good lady of the house, who was in the habit of showing me consideration in small things, such as giving me hot water every evening. In thanking her, I used the phrase "Vous êtes très aimable." That night, I followed my usual custom of reading a French book, and came across the word *aimable* several times. It started a train of thought which soon drifted to others. The word *aimable* is derived obviously from the French verb meaning "to love," and, used as I used it, was meant to express what we in

English would call amiability or kindliness; but, how differently we can use the French term "aimable" from our own word "amiable," and with which it has a common root origin through the Latin. Most of us would hesitate to apply the word "amiable" to anyone we really cared for; with us, to be amiable, or display amiability, is tantamount to saying that we display a negative quality which is consistent with all-round popularity. It dawned on me that the very quality of amiability is not unlike the mignonette of my friend the farmer, for there is something destructive in its sweetness, because very amiable people have no other marked characteristics. Amiability seems to destroy enthusiasm and passion in its possessor, and yet is never found together with serious faults. Many of us can say, and have said, of men we have known, "He was a very amiable man," and yet, when we have heard of his death, how many of us have really missed or regretted the man? It would seem as if the great human qualities are weakened by amiability, and that very amiable people never come very near to anyone else; they seem isolated by the fragrance of their personal atmosphere. If this be so, then in spite of its possessor being often impervious to pain, usually free from worry, very little capable of resentment, and never short of companions, yet amiability itself is nothing more than what may be called a destructive virtue, much as the mignonette and the convolvulus are destructive plants to other flowers.

As one thought over the question, one could not help wondering whether to be methodical could be counted as a virtue; its destructive influence is obvious. To most people with any marked faculty for method it becomes an end in itself, and they suppress gradually in themselves all wish for anything but order, being content to find systems in stones and method in everything. Carried to an extreme, the craving to arrange and methodize is another destructive virtue. Similarly, self-control, if over-developed, is apt to dwarf other characteristics. Yet, it is a fine quality and one far removed from the animal. We all admire the man whose self-command is perfect, but few of us find it possible to like him. Reluctantly, one classes self-control among the destructive virtues because, if a man becomes a tyrant over himself, he will destroy his personality as surely as he would destroy that of any other victim of his over-developed will-power. Then there is jealousy, which some people call a vice. Certainly, in some of its forms it is a dominant quality, but, in conjunction with love, jealousy is hardly a vice, does not destroy other virtues, though it may be an inconvenient quality. Among animals jealousy is an undoubted

virtue, for a dog without jealousy is no better than a cat—a mere intelligent animal, and without real devotion to his master. It is the jealousy dissociated from passionate love which may be called the weed of character that squeezes out all that is best and most human. In that form, jealousy destroys both geniality and sympathy, and gives birth to spite. The only antidote or remedy for jealousy is success, and when success comes we often see a great change in a jealous man's character, and his virtues blossom into life. Why should it be so? The answer probably is, that the good qualities which then flourish were always there, but atrophied because they could not grow. The bindweed of jealousy has been eradicated.

There is a current belief that the musical faculty destroys others. One doubts it, because all the great composers have been men of strong minds. In the same way, great mathematicians are often twitted as being of no ability outside their own sphere of mental activity. We question whether the aspersion is justified, but rather due to the fact that the special talent of the mathematician arouses in peculiarly abstract forms of mind a kind of jealous contempt. Equally, histrionic power and the literary faculty are held to be inimical to other qualities. Logically, this would seem to be impossible, for to be either a good actor or a good writer a man should have wide sympathies and a deep understanding of human nature. One conceives that some actors have a good bit of the ape in their composition, and in so far as acting consists of mere imitation it may kill other talents, but such acting is never great. To think that the literary faculty unfits a man altogether for active life implies either the thinker has no literary faculty himself, or he relies too much on a mere verbal division between men of thought and men of action. On the other hand, literary and artistic people betray often a curious contempt for the thought-power of men of action. The weight of evidence suggests that wholly intellectual abilities do not destroy others and are not within the category of destructive virtues. The truth probably is that *l'intelligence est bonne à tout*. So much, then, for thoughts as to whether certain qualities, like certain crops and flowers, take too much goodness out of the character and ground. Further development of the theme is left to the reader.

V.

Not long ago, I was watching some swallows and martens collected on a telegraph wire at sundown, in that manner so characteristic of those birds just before they make their migrant flight at dawn to warmer climes. This migration, to most people, is a sort of sentimental mystery, and I myself was not altogether free from that feeling. One's thoughts wandered through many phases, but broadly they took the following form: One realized that the wings of those birds, which they were so sedulously preening and making fit for the task before them, were primarily organs designed for the great passage into the path of the sun; and it was really of the great part which the sun plays in our cosmos that one began to think.

Every reader knows that the chief food of green plants is the carbon in the atmosphere, and that animals, including man, return this element to the air. Each lives on the waste product of the other. But throughout this interchange, the amount of carbon in the atmosphere remains the same. Plants can extract this carbon food from the air only in sunlight, hence the convenient biological statement that plants fix solar energy and animals release it. This practically constitutes the phenomenon which we call "life." The more sunlight, the more plant life there will be in any locality, and the greater the amount of plant life the more animal, including insect life, will be supported. Under the simpler conditions of early centuries, when the vegetation died down each autumn in the Northern Hemisphere, the balance of life was redressed by a highly locomotive or peripatetic set of organisms, which passed at once across the Equator to feed on the surplus life of the Southern Hemisphere. The birds and fishes carrying out this duty we now call migrants, and my friends the swallows and martens were an example of present-day exponents of the fact. I do not know much about geology, but the thought here suggests itself that the precession of the equinoxes, with its sequential disturbances of plant life, may explain the otherwise inexplicable extermination of the very highly wandering animals of past ages, and that in their extinction lies the lesson that the ultimate reward of the migrant is inevitably extinction. In support of the seeming unjustifiability of this view is the fact, well known to naturalists, that during the past few centuries the world has experienced an enormous shrinkage of migrant birds and fishes. Yet the chemical composition of the atmosphere proves

that the function of migration must still be working in some way or another. The real truth is, man is now the migrant; but, for the first time in the history of the world, he migrates by proxy. Biologically, the earth is lop-sided. Sunlit lands, with all their richness in vegetation, are not now the centre of animal life. Their crops are garnered, as wheat or plant-fed beef, and sent to other lands to be resolved again into their elements.

Tracing this thought to its logical conclusions brought one to the fact that we British are now the chief nation functioning as a migrant. Any cutting off of our overseas traffic would mean that the carbon carefully gathered in Australia, India, the Argentine, Russia or North America would not be released. The following season would see the plants getting their sunlight, but they would be without their usual food: or, if the crops were fortunate enough to be devoured locally, it would only be by agricultural pests ever ready to blaze out in overwhelming hordes at any slackening of human effort. Thus, a vista rises in view of a cosmic chaos, and the intelligent reader will solve readily the simple sum presented in biological arithmetic. But few of us have yet grasped the fact that our world is one great organism, making the very utmost of the energy poured on us by the sun. When the work of migration was carried on blindly by millions of birds, mammals and fishes, the risk of a sudden disturbance of the balance was small. To-day, the channels of impounded sunlight are the fragile threads of ocean-borne traffic. Should they be cut, not only the central ganglion would die, but the effects would reach also to the minutest ramifications in every land that is not actually savage. If we think of our own race, we realize how deeply we as a nation are specialized in our task. In spite of the optimistic visiōns of some biologists, we cannot increase the carbon in the air nor attract more solar energy to our country. Our only hope is in keeping the mastery of the seas, not only for our own sakes but for the safety of that curious and delicate phenomenon called civilization. Should the enemy at our gates destroy us, she destroys merely a fellow organ in the great body of the world, and unless she or another can promptly create new trans-equatorial channels of migration, then our defeat in a present-day struggle would constitute a biological world disaster. The fate of nations clearly rests on the green plant. All vegetarian races supply the proof, and the plant in turn depends not on the soil, nor even on water, so much as on sunlight. And so my companions on an autumn evening, the swallows and the martens, bring us back to the ancient pagan doctrine that the sun is the source of all life.

VI.

A few weeks ago I was billeted in the same house with a man who had a perfect mania for collecting things. At home he was an ardent collector of stamps and coins; in France he rummaged about in shops and collected buttons, badges, fuses, scraps of shell and numerous other odds and ends. I often went into his room and marvelled at the queer assortment of things he used to be sending home. He was a genial fellow, but—alas!—killed on September 26. I often think of him and his mania for possessing things. As one has thought of him and his ways, it has occurred to me that surely a too keen sense of possession or a too great love of owning things must have a bad intellectual effect. I do not refer here to my dead friend in particular, but rather to that general mass of people who spend considerable sums of money and devote all their spare time and mind to the making of collections of no special value, such as autographs, stamps, coins, medals, pictures and first editions. It would seem as if men become possessed by the love of possession. Undoubtedly, some men must have a pursuit which is the most acceptable recreation, and, if a man keep his hobby within bounds, all is well; but a pursuit which makes an immense demand on the attention must narrow a man's interests and sap his mental powers. All the time, energy and thought which the man who pursues possessions wastes can and would be given to a cause by the man who sets no store on possessions. This latter is what we call a detached man. The detached men of the world, however, do not govern it; they often accomplish great things because they are not in sympathy with their fellows, but their deeds are done alone though done for others. These are the type who do not even hold their lives dear, and though we admire them we cannot help feeling divided from them. We all know men and women in the world to whom worldly considerations mean nothing, and to whom human relationship even means little. It is difficult to gauge their influence. They are not without deep affections, but these are not called out by what may be called the sense of possession. People of the kind, even if they have great blessings in the way of good wives, children or parents, do not care for them because they are theirs, consanguineous, or sharers in property or traditions. These detached people or those devoid of the sense of possession seem a type apart. They cannot realize that the true argument for private property is that man must own or be unhappy. Few of us are wishful to be rid of the sense of possession; we could as easily give up our identity. Each

one of us has some consolation under our own roofs and in the contemplation of our *lares et penates;* our pretty things make us feel at home, and it is really our possessions which render home dear.

Then, in contrast to my dead friend, there is a type of person who seems to be devoid of the sense of possession, and yet is distinct from what one calls the detached man. It is that happy individual who seems to possess all things. His neighbour's goods are his provided that he has opportunity to enjoy them. He walks through a man's estate, enjoying Nature and all her beauties, with no sense that he is on someone else's land. He goes into a picture gallery, and by mere looking at those pictures feels they are his own, or he goes to some public library and feels that all the books that were ever written are his own. He does not want to have them for his own, simply because he does not know what "own" means. Most of us have met people of this kind. Their temperament is such that they can never be miserly, worldly or judge themselves or others by a money standard. These are the happy people who never grudge because they never envy, but their curious defect makes them rarely energetic, simply because the desire of gain is lacking. On the other hand, should some aim or cause take possession of them they may be energetic, and if the cause be a good one they are sure to excel in goodness. Their great asset is, they are free of so many temptations. The conclusion one reaches is, that where there is no strong sense of possession in a man all blows and disasters can be recovered from. People without this curious sense are undoubtedly a credit to human nature, but all the same they are not quite human. In spite of his curious foibles and queer desires of possession, one will ever think of that dead friend as typically human. May he rest in peace!

VII.

Duty took me, one morning a few days back, to a certain area in France over which lay scattered many hundreds of dead, the aftermath of a battle. But a few hours later I accompanied a certain corps commander to inspect what remained of a battalion which had greatly distinguished itself on that area. One could not fail to be impressed by the two incidents, and, as one reflected over them afterwards, a current of thought surged through one's mind which voiced itself in much the following words: Never before has there been so terrible a loss of young lives, or so many

of the fairest energies and aspirations of men flung so ruthlessly into an abyss whence comes no sound or answer; and also never before had one seen finer incarnations of physical and moral vigour, of intellect and glorious promise, paraded fresh from the jaws of death and yet ready each one to risk again their all for their country's cause. It needed a heart of stone and a brain of brass to be irresponsive to all the lessons presented. One remembered that for fourteen months the bravest, truest and most self-sacrificing had been the first to die, and that the less courageous, the less generous, the weak, the ailing and all the less desirables alone received the chance of escaping carnage. The picture was clear of a kind of monstrous inverse selection having been in operation, and a selection which seemed to be seeking deliberately the downfall of the human race. It was impossible not to wonder uneasily what will be the state of the western world after this great trial, what will be left and what will be the future of these depleted races, shorn of all that was best and noblest in them.

Truly, a dark problem and containing a tangible truth against which we are defenceless. But are not tangible truths nothing more than salient angles of greater and deeper-lying truths? The thought is irrepressible that man appears to be such a necessary force of Nature that he has, hitherto, always not only survived desperate ordeals, but succeeded in benefiting by them and emerging greater and stronger than before. We know that the removal of a million or more young existences, cut down just as they were bearing fruit, will leave a void that will not be readily filled, just as we know that among those dead were great intellects and treasures of genius which will not come back again, and which were the depositories of inventions or discoveries that will now, perhaps, be lost to us for centuries. We know that had this cataclysm not befallen the civilized world, mankind would have advanced appreciably to achievements impossible to foreshadow. We know also that had but a fourth part of the sums expended on destruction and extermination been devoted to the works of peace, we should have advanced to the sane amelioration of social questions. Above all things, we know that we shall never grasp the consequences of this thrusting back of progress and of this unprecedented devastation. Yes, we know all this, but we need not despair, for there is no irreparable loss. Another and sustaining thought comes along, and it is that nothing perishes, everything is transformed. Our moral world, like our physical world, is surely a vast but closed sphere, whence naught can issue and whence

naught be lost. There is no escape or leakage, no waste, and all that existed or comes into being upon this earth remains in some form or other and bears fruit in due season. The most appalling losses are but material or spiritual riches flung away for an instant, to fall again to the ground in some new form. If these thoughts be legitimate, we recover our balance and stand upon our feet.

Arguing to oneself in this way, and unless some unrecognized fallacy underlies the thought, we realize that all that our wonderful dead relinquish, they bequeath to us; and when they die for us, they leave their lives to us in no mere metaphorical sense, but surely in a very direct and real manner. We lose some dear and gallant friend, but the virtue which went from him, as he fell performing a deed of glory, is ours still, and falls surely on us. One finds consolation and very real confidence in the belief that nothing of him was lost or dissipated in the shock of a premature end. He simply gave us in one deed what he would and must have given us in a long life of duty. In this manner, we conceive all the heroism poured out around us as not leaving this planet: and the reason of the courage of the living lies in the might of the dead having passed into those who survive. Not only so, we conceive all those forces of wisdom, confidence, self-sacrifice, patience and honour which we feel arising within us, without knowing why or whence they come, as but the souls of the heroes gathered and absorbed by our own souls.

The pragmatic reader may say I am a dreamer and writing metaphysical nonsense. It may be or it may not be so. I write my thoughts as they come, for better or for worse, and recognizing that it is as well ever to contemplate invisible things seriously, and as though we see them with our eyes. Every race has given this mysterious verity not only a name but a place as an instinctive, essential and guiding principle towards the estimation of ethical values. To the Aryans, it appears as the transmigration of souls or reincarnation; to the Japanese, it is ancestor worship; while to me and to some others, it may be called the revival of merit. When this War is over, it will be interesting to see if the same thing happens then as has occurred after previous long and exhausting wars, namely, an extraordinary increase in the birth-rate. It is to be hoped that there will be, and it is difficult to avoid visualizing that prosaic event as being but the picture of the lives, suddenly cut short in their prime, as not really lost and dead but hurrying, as it were, to return to us to complete their career.

There is no difficulty in conceiving the same of moral forces that seem to be lost and wasted on the battlefield. In spite of the inherent difficulties of the subject, one cannot get away from the belief that the dead never die. More than that, the thought of unceasing change in individual lives, but never change or loss in the aggregate of Life, seems to be the great thought which must console. The number of lamps may grow less, but the flame rises ever higher, and what death takes from those who fall enters into those left standing; which means, surely, that death is in no wise the gainer so long as there are living men to carry on the work of man. This philosophy may not be acceptable to all, but it is a philosophy which represents the musings of an idle man, given in no spirit of dogmatism, but to be thought over by others in similar circumstances.

REPORT ON THE BACTERIOLOGICAL EXAMINATIONS CARRIED OUT AT THE MANCHESTER CEREBRO-SPINAL FEVER LABORATORY (PUBLIC HEALTH LABORATORY), DURING THE YEAR ENDING JULY 27, 1915.

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THE routine examination of cerebrospinal fluid consisted in (1) taking note of the physical characters, and (2) making a microscopical examination of the sediment obtained by centrifugalization, followed by (3) cultivation tests.

Film preparations fixed by heat were stained by:—

(1) Pure medicinal methylene blue (Merck) ten per cent.

(2) Gram, counterstained Bismarck brown or weak carbolfuchsin.

(3) Ziehl for tubercle bacilli.

Primary cultures were made on solid glucose bouillon serum—usually known as Loeffler's serum. Some of the sediment and fluid was also added to a tube of liquid serum. It sometimes happened that a growth was obtained on re-inoculation from the liquid serum when the primary solid serum tubes gave no growth.

In all the cases where cultures gave a positive result the meningococcus was also found by microscopical examination. In one case (C.S.F. 180) on microscopical examination an organism closely resembling the meningococcus was seen, but further tests proved it to be a streptococcus.

The meningococci isolated from the positive cases showed typical microscopical and cultural characters with one exception (C.S.F. 220). In this case only a few meningococci were found by microscopical examination, and by cultures from liquid serum an organism of somewhat aberrant type was obtained. In young cultures it occurred in coccus and diplococcus forms, staining well and uniformly by ordinary stains and arranged in groups. It fermented glucose and maltose but not saccharose and did not grow at 23° C. The growth was thinner, more opaque and less glistening than a typical meningococcus.

In three of the negative cases cultures were obtained of organisms having some resemblance to the meningococcus (C.S.F. 103, 249, 250). In C.S.F. 103 a coccus resembling the meningococcus microscopically was found which fermented glucose and saccharose and grew well at 23° C.

In C.S.F. 249 the coccus found fermented glucose and maltose, but not saccharose, and grew well at 23° C. Its microscopical characters differed from those of the meningococcus.

The coccus from C.S.F. 250 fermented glucose and maltose and had a slight action on saccharose. It grew well at 23° C. Microscopically it did not resemble the meningococcus very closely and on staining by Gram did not lose the stain so readily on decolorization.

In a few instances obvious impurities were present. In many of the civil cases the fluid was not received at the laboratory until some hours after collection, but it does not appear that a wrong bacteriological diagnosis was made in any instance through a failure of the meningococcus to grow. In one instance the meningococcus was isolated from a specimen of fluid collected fully twenty-eight hours before arrival. Some observations are now being made on the vitality of the various strains obtained during the past year.

Examination of Nasopharyngeal Swabs.

On arrival at the laboratory an emulsion was made from the swab with a small quantity of peptone bouillon. This was spread over the surface of one or two Petri dishes containing neutral red glucose serum by a platinum spatula in successive strokes. The plates were examined after twenty-four and forty-eight hours' incubation with a low-power objective and sub-cultures and cover-glass preparations made from any suspicious colonies seen. Some plates were kept under observation for longer periods,

A typical meningococcus was found in one case only.

Organisms resembling the meningococcus were found in thirty-six instances. They may be arranged in four groups:—

(1) Fermenting both glucose and saccharose	Found in 29 cases.
(2) Fermentation of glucose doubtful or slight. Saccharose not fermented	" 3 "
(3) Fermentation of glucose. Saccharose not fermented. Growth at 23° C.	" 3 "
(4) No fermentation of either glucose or saccharose	" 1 case.

Gram-negative diplococci, closely resembling the meningococcus, are frequently found in swabbings from the nasopharynx, and there is often considerable difficulty in arriving at a definite diagnosis.

The question arises whether some of these organisms are meningococci which have become somewhat modified, and also whether the criteria at present generally accepted can be relied upon. An attempt has been made to preserve cultures of most of those doubtful organisms in order to apply serological and other tests with those capable of growth.

Before a sufficient supply of the special form of apparatus,

devised by Professor Delépine for collecting nasopharyngeal swabs, could be prepared and distributed to various sanitary authorities many of the swabs were taken on ordinary diphtheria outfits. The bacteriological flora of the nasopharynx differs from that of the fauces and tonsils, and the necessity for special apparatus in collecting material is beyond question.

The full results of this investigation are given in the tables, and some further points of interest are given in the notes following the tables.

Notes on Culture Media.

In the Public Health Laboratory, Manchester, glucose bouillon serum has been used as the ordinary culture medium for the meningococcus for many years, and has given excellent results. It is advantageous to tint it faintly with neutral red (1 in 10,000), as originally recommended by Dr. Buchanan (*Lancet*, June 8, 1907). The neutral red may be either mixed with the fluid serum before sterilization or merely poured in a thin layer on the surface of the sterilized medium. The meningococcus produces characteristic colonies, having a faint coral pink tinge; and there is little or no staining of the surrounding medium. In tubes containing some water of condensation, a yellowish deposit is often seen. The medium is transparent and very slightly darker than ordinary serum. It has been extensively used in the form of plates in Petri dishes during this investigation. Other culture media have been tested, including:—

Dorset's egg medium (tinted or not with dilute fuchsin).

Defibrinated rabbit's blood agar (Dr. Hunt's medium).

Agar spread on the surface with human or guinea-pig's blood.

Nasgar
Legumin agar } Media kindly sent by Major Gordon.

Defibrinated guinea-pig's blood agar.

All these media yielded a good growth of the various strains of meningococci, but they do not possess any advantage over glucose bouillon serum. They may be found very useful in cases where a constant good supply of serum cannot be obtained.

The sugar reactions were tested on solid serum tubes containing 0·5 of the sugar (glucose, maltose, or saccharose), and tinted with either neutral red (1 in 10,000), or litmus in sufficient quantity to give a distinct tinge (0·75 per cent of 10 per cent watery solution).

There is but little to choose between neutral red and litmus as indicators; but many organisms with a neutral red indicator produce a diffuse red staining of the medium which is not usually seen with the meningococcus. Fluid media were found to be unsatisfactory for sugar reactions.

A.—Results of Examination of Cerebrospinal Fluid in Cases of suspected Cerebrospinal Fever.

(1) *Military Cases.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Microscopical Examination			Cultivation of Fluid		Reference to notes * and to other specimens
								Growth		
					Cells	Meningococcus	Other bacteria	Meningo-coccus-like	Not meningo-coccus-like	
7 (31)	14.3.15	2nd W., Whitworth St., Manchester	35	M.	Poly. +++ Lymph. +++	–	–	–	–	151*
14	17.3.15	2nd W., High St., Manchester	23	M.	–	–	–	–	–	44*
21	23.3.15	2nd W., Princess St., Manchester	24	M.	–	–	–	–	–	*
31 (7)	1.4.15	Monsall Hospital, Manchester	35	M.	Poly. +++ Lymph. +++	+	–	+	–	151
58	10.4.15	Bucknall Isolation Hospital, Stoke-on-Trent	23	M.	Poly. +++	+	–	+	–	*
59	10.4.15	Monsall Hospital (22, Marple Street, Openshaw)	45	M.	Poly. +	+	–	+	–	
134 (154)	22.5.15	Chadderton Camp, Oldham	18	M.	Poly. + Lymph. ++	–	–	–	–	135, 136, 147, 148.
158 (174)	29.5.15	2nd W., Whitworth St., Manchester	20	M.	Poly. +++	+	–	+	–	Swab, urine, blood, P.M. *
175	2.6.15	,, ,,	32	M.	(Blood)	–	–	–	–	Swab (175). Blood ,, *
176	2.6.15	,, ,,	20	M.	–	–	–	–	–	Swab (176). Blood ,,
177	5.6.15	2nd W., High St., Manchester	21	M.	Poly. +++ Lymph. ++	–	+	–	+ Colon B.	Swab, blood, urine, 177.
179	7.6.15	33, Stott Street, Failsworth	33	M.	Poly. +++ Lymph. +++	–	+	–	+ *B. coli*	*
180	8.6.15	Ancoats Hospital	23	M.	Poly. +++	– ?	+ Strep.	–	+ Strep.	Swab, 180.* Blood, P.M.
193	14.6.15	Cecil Road Hospital, Hale	19	M.	–	–	–	–	–	Swab, 193.* Blood, 193. Urine, 193.
247	9.7.15	Nell Lane Hospital, Withington	19	M	–	–	–	–	–	Swab, blood, urine.

Ref. No. in C.F.S. book.

Notes relating to Cases in Table A (1).

7 First examination. Fluid collected about sixteen days after onset. Cultures made within thirty minutes of collection.

14 Recovered. Probably not cerebrospinal fever.

21 Recovered. Not cerebrospinal fever. Probably influenza.

31 Second examination. Fluid collected about a month after onset.

58 Fluid collected 1.30 p.m. Cultures made about 10.30 p.m.

134 Diagnosis from microscopical examination probably tubercular. Confirmed by P.M. Blood C.S.F. 135, 147, swab 136, urine 148, P.M. material 154.

158 Fluid collected about forty-eight hours before arrival at laboratory and not incubated or refrigerated.

175 Recovered. Not cerebrospinal fever.

176 Septicæmia following shrapnel wound of abdomen. Died.

177 Coli infection following shrapnel wound of abdomen. Recovered. Bacillus coli isolated from cerebrospinal fluid and blood.

179 Cerebral abscess following middle ear disease. Post-mortem Captain Tylecote.

180 Cerebral abscess following gunshot wound of brain. Streptococcus infection. Microscopical examination of fluid disclosed some cocci closely resembling meningococcus, some retaining gram and some not. Mostly intracellular. No chains but have not quite typical diplococcus form. Streptococci by cultures.

193 Quantity of fluid very small (a few drops; no more could be obtained). Not cerebrospinal fever.

247 Not cerebrospinal fever. Obscure case. Operation 6.7.15, for removal of shrapnel fragments lying on sciatic nerve. Suspected tetanus.

A.—Results of Examination of Cerebrospinal Fluid in Cases of Suspected Cerebrospinal Fever.

(2) *Civil Cases.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Microscopical Examination: Cells	Microscopical Examination: Meningococcus	Microscopical Examination: Other bacteria	Cultivation of Fluid, Growth: Meningococcus-like	Cultivation of Fluid, Growth: Not meningococcus-like	Reference to notes * and to other specimens
1	3.9.14	13, Dora Street, Manchester	4	F.	Poly. +++	+	−Gram bac. +Gram bac.	− −	−	*
2	14.9.14	177, Urmston Road, Stretford	16	M.	Lymph. +	−	−	−	−	*
3	11.2.15	30, Lewis Street, Patricroft	10	M.	No cells	−	−	−	−	*
4	1.3.15	Summerville, Irlam on the Height	30	F.	Poly. ++ Lymph. ++	−	Minute B. Small number	−	−	*
5	2.3.15	9, Berkeley Avenue, Levenshulme	31	M.	Poly. + Lymph. ++	−	−			
6	6.3.15	Clifton Hall, F. Cottage, Clifton, Manchester	13	F.	Poly. + Lymph. ++	−	T.B. +			
9	16.3.15	6, Thompson Street, Strangeways, Manchester	7	F.	Poly. ++ Lymph. ++	+	−	+		
15 (43)	18.3.15	Colwyn Bay	16	F.	−	−	−	−	−	*
20	21.3.15	Ancoats Hospital, Manchester			Lymph. +++	−	−	−	−	*
22	24.3.15	Lymm	45	M.	−	−	−	−	−	*
27	25.3.15	170, Manchester Road, Altrincham	41	F.	A little blood	−	−	−	−	*
28	26.3.15	Ashton	19	F.	Lymph. +	−	−	−	−	*
30	30.3.15	20, Slater Street, Middleport	11	F.	Lymph. +	−	−	−	−	*
43 (15)	4.4.15	Colwyn Bay	16	F.	−	−	−	−	−	*
45	7.4.15	4, Newfield, Lymm	34	M.	−	−	−	−	−	46*
57	10.4.15	34, Alice St., Bradford, Manchester	10	M.	−	−	−	−	−	*
61	13.4.14	Manchester			−	+	−	−	−	*
70	14.4.15	Salford			Poly. +++ Lymph. +			+	Large bact.	159
82	20.4.15	24, Holly Street, Tottington	11	F.	Poly. +++ Lymph. ++	+	−	+	−	
83	24.4.15	12, Radford Street, Darwen	32	F.	..	+	−	+	Staph.	*
88	27.4.15	136, Springdale St., Huddersfield	5	F.	Poly. + Lymph. +	−	−	..	Coccus (prob. skin organism)	*
91	28.4.15	245, Hyde Rd., Gorton, Manchester	9	M.	Poly. +++	+	−	+		
103	3.5.15	4, Hayley Street, Longsight, Manchester	$\frac{10}{12}$	M.	Poly. ++ Lymph. ++	−	−	− ?	+Gram coccus −Gram coccus	*
111 (120)	8.5.15	Moss Side Hospital, Lytham	8	F.	?	−	−	−	+	150
113	8.5.15	61, Pemberton St., Cheetham, Manchester	1	F.	Blood	−	−	−	+coccus	*
115	10.5.15	9, Lilian Square, Ardwick		M.	Lymph. + Poly. +	−	−	−	−	*

A.—RESULTS OF EXAMINATION OF CEREBROSPINAL FLUID—*continued.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Microscopical Examination			Cultivation of Fluid		Reference to notes * and to other specimens
								Growth		
					Cells	Meningococcus	Other bacteria	Meningo-coccus-like	Not meningo-coccus-like	
117	12.5.15	9, Queen's Rd., W. Didsbury, Manchester	2	M.	Lymph. +	–	–	–	–	116*
118	13.5.15	43, Tudor Street, Oldham	34	F.	Blood Poly. +	+	–	+	–	
120 (111)	18.5.15	Moss Side Hospital, Lytham	7	F.	Blood Poly. ++ Lymph. +	–	–	–	–	*
153	27.5.15	13, Euclid St., Beswick, Manchester	11	M.	Poly. + Lymph. +	–	T.B. +			
160	31.5.15	7, Darwen Street, Weaste	18	M.	–	–	–	–	–	Swab, urine, blood*
178	7.6.15	6, Consterdine St., Miles Platting, Manchester	2	M.	Lymph. +	–	–	–	–	*
202	15.6.15	St. Joseph's Industrial School, Manchester	13	M.	Lymph. +	–	–	–	–	*
213	22.6.15	13, Brigham Street, Openshaw, Manchester	8	M.	Lymph. +	–	–	–	–	*
218	28.6.15	Ladywell Sanatorium, 33, South Short St., Salford	4	M.	Blood Lymph +	A few large slender bacilli	–	–	–	*
219	29.6.15	Bucknall Hospital, Stoke-on-Trent	21	M.	Poly. + Lymph. ++	–	–	–	–	*
220	30.6.15	,, ,,	21	M.	Poly. + + Lymph ++	+	–	+	..	*
225	30.6.15	6, Hope St., Hanley	42	F.	Blood	–	Large bact.	–	Large bact.	*
230	30.6.15	,, ,,	42	F.	Blood	–	Large bact.	–	Large bact.	*
231	3.7.15	Liverpool Farm School, Newton-le-Willows	18	M.	Poly. +++ Lymph. +++	–	Pneumococci	–	Pneumococci	
239	8.7.15	3, Thomas Street, Eccles	4	M.	Lymph ++	–	–	–	..	*
246	8.7.15	Crumpsall Infirmary	5	M.	Poly. + Lymph. ++	–	–	–	–	*
248	10.7.15	Fever Hospital, Newton-le-Willows, 63, Haydock St., Earlestown	8	M.	Blood	–	–	–	–	*
249	11.7.15	1, Ann Street, Northwich	1	M.	Lymph. ++	–	–	–	–	*
250	13.7.15	Ancoats Hospital, 24, Ridgway St., Longsight	14	M.	Blood	–	–	–	–	*
251	15.7.15	Hilton St., Darwen	24	M.	Blood	–	Many bact.	–	Impure cult.	*
253	20.7.15	14, Walker Street, Manchester	$\frac{4}{12}$	F.	Poly. +++ Lymph. +	+	–	+	–	255

NOTES RELATING TO CASES IN TABLE A (2).

C.S.F. Ref. No.	
1	Microscopically meningococci and bacilli of two kinds found. Fluid collected post mortem about twelve hours after death. No growth on culture media. Cultures about thirteen to fourteen hours after death. No growth. Clinically cerebrospinal fever.
2	Not cerebrospinal fever. Case of Landry's paralysis. Fatal termination in four days.
3	Recovered. Said to be a "typically tubercular" patient.

NOTES RELATING TO CASES IN TABLE A (2).—*continued.*

C.S.F. Ref No.

4 Died. Onset of illness 15.2.15 Death 24.4.15. No post-mortem. Probably influenza, not cerebrospinal fever. No growth by cultures. Minute bacilli microscopically.

5 Not cerebrospinal fever. Cerebral tumour.

15 First examination. Quantity of fluid too small. Probably not cerebrospinal fever. No further information (see 43). Collected five days after onset.

20 Probably tubercular. No information.

22 Probably a case of cerebrospinal fever. Material sent was not cerebrospinal fluid, but merely a small quantity of blood; needle used was too short to reach spinal canal.

27 Probably not cerebrospinal fever. No information.

28 Case of syphilis. Not cerebrospinal fever.

30 Not cerebrospinal fever.

43 Second examination (see 15). Collected twenty-two days after onset.

45 Probably not cerebrospinal fever. No information.

57 Not cerebrospinal fever. Diagnosed as tubercular or septic.

61 Not cerebrospinal fever clinically.

83 Impure cultures obtained containing meningococci and staphylococci.

88 Probably not cerebrospinal fever.

103 Probably not cerebrospinal fever. Fatal case. No post-mortem allowed. Material sent not satisfactory, about three to four cubic centimetres and sent in ordinary diphtheria tube with swab inside. Collected ten days after onset. Cultures made within an hour of collection. Further material asked for but could not be obtained ("dry" punctures). A coccus having some resemblance to meningococcus isolated by culture and also a Gram + staphylococcus.

111 Doubtful cerebrospinal fever. No information. Quantity of fluid very small, about half cubic centimetre. Badly sent, insufficiently sealed in typhoid pipette. First examination (see 120).

113 Impurities by culture. Insufficient information. Probably not cerebrospinal fever.

115 Probably not cerebrospinal fever. Fluid collected about eight weeks after onset of illness.

117 Probably tubercular.

120 Second specimen (see 111). Collected ten days after first specimen. Doubtful case.

122 Diagnosed clinically as cerebrospinal fever.

160 Fluid collected eighteen days after onset. Probably not cerebrospinal fever. Recovered.

178 Not cerebrospinal fever. Diagnosed clinically as tubercular.

202 Not cerebrospinal fever. Pneumonia.

213 Probably tubercular.

218 Fluid collected ten days after onset. Probably tubercular.

219 (First specimen.) Fluid collected 4 p.m. 27.6.15. Arrived morning of 29.6.15 (about thirty-eight hours between collection and making of cultures). A few doubtful meningococci microscopically. No growth.

220 (Second specimen.) Collected 29.6.15. Arrived 30.6.15 morning post. Culture from incubated material only. Atypical. Thinner, more opaque, less glistening.

225 Not cerebrospinal fever. Post-mortem. Cerebral hæmorrhage. Hemiplegia. First specimen.

230 Not cerebrospinal fever. Post-mortem. Cerebral hæmorrhage. Hemiplegia. Second specimen.

239 Quantity of fluid very small—about 1 c.c. Badly sent and probably contaminated. Clinically cerebrospinal fever. From incubated material, coccus having some resemblance to meningococcus isolated. Microscopically very small coccus in groups with a few lanceolate forms, but no diplococci, not resembling meningococcus very closely. Reaction to Gram uncertain but stain retained to a certain extent. Grows well at 23° C. Reactions on media containing sugar resemble those of meningococcus, with the exceptions that after forty-eight hours' incubation there is a trace of acidity with saccharose medium, and glucose neutral red medium shows a diffuse staining.

246 Diagnosed clinically as tubercular.

248 Not cerebrospinal fever. Scarlet fever.

249 Fluid collected 10.7.15. Arrived 11.7.15. Diagnosis clinically tubercular. From incubated material coccus isolated having some resemblance to meningococcus. Reactions on sugar media like those of meningococcus. Grows well at 23° C. Microscopically very minute coccus in groups, no chains or diplococci.

250 Doubtful case, probably tubercular. From incubated material coccus isolated having some resemblance to meningococcus. Microscopically a very small coccus, some elements oval in form, arranged in groups, no chains or diplococci. Culture more opaque, grows readily at 23° C., ferments glucose and maltose and also saccharose slightly after forty-eight hours' incubation. Does not stain by Gram but decolorizes more slowly than meningococcus.

251 Not cerebrospinal fever. Diagnosis uncertain.

B.—Results of the Examination of Swabbings from the Nasopharynx of Suspected Primary Cases.

(1) *Military Cases.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Reference No. of primary case	Cultivation at 37° C. on Glucose P.B. Serum							Reference to notes * and to other specimens
						Growth							
						Meningo-coccus-like		Not meningococcus-like					
						Typical	Atypical or doubtful	Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	
14	6.4.15	2nd W., Whitworth Street, Manchester	23	M.	14	–	–	..	..	No notes			*
44	6.4.15	,, ,,	23	M.	14	–	–	..	..	No notes			14 *
98	29.4.15	Ladywell Sanatorium, 36, Atherton Street, Peel Green, Eccles	36	M.	..	–	+	..	+	..	..	..	*
136	22.5.15	Chadderton Camp, Oldham	18	M.	134	–	–	..	+	+	..	..	134, 135, 147, 148, 154 *
151	26.5.15	Monsall Hospital, Manchester	35	M.	31	–	–	..	+	..	..	Large B. Small B.	7, 31 *
175	2.6.15	2nd W., Princess Street, Manchester	32	M.	175	–	–	..	+	..	..	Yeasts Small B.	*
176	2.6.15	2nd W., Whitworth Street, Manchester	20	M.	176	–	–	..	+	+	..	..	*
177	5.6.15	2nd W., High Street, Manchester	21	M.	177	–	–	..	+	+	..	..	*
180	8.6.15	Ancoats Hospital, Manchester	23	M.	180	–	–	..	+	+	..	Small B.	*
193	14.6.15	Cecil Road Hospital, Hale	19	M.	193	–	–	..	+	+	..	..	*
247	9.7.15	Nell Lane Hospital, Withington, Manchester	23	M.	247	–	–	..	+	..	..	..	*
		Suspected Carriers.											
76	17.4.15	Clackmannan Fever Hospital, 25, Cobden Street, Alloa	32	M.	..	–	–	..	+	+			
192	14.6.15	2nd W., Whitworth Street, Manchester	27	M.	..	–	+						

Notes relating to Cases in Table B (1).

C.S.F. Ref. No.	
14 & 44	Cerebrospinal fever negative.
98	Probably not cerebrospinal fever.
136	Tubercular meningitis. Fluid, blood (two samples), urine and post-mortem material also examined.
151	Swab of a positive case after recovery.
175	Negative case. Blood also examined. Influenza.
176	Negative case. Blood also examined. Septicæmia.
177	Negative case. Blood and urine also examined. Septicæmia. *Bacillus coli* infection.
180	Negative case. Blood also examined. Cerebral abscess. Streptococcus.
192	Had cerebrospinal fever in January, 1915. Recovered. Suspected carrier.
193	Negative case. Blood and urine also examined.
247	Not cerebrospinal fever.

B.—Results of the Examination of Swabbings from the Nasopharynx of Suspected Primary Cases.

(2) *Civil Cases.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Reference No. of primary case	Cultivation at 37° C. on Glucose P.B. Serum							Reference to notes * and to other specimens
						Growth							
						Meningo-coccus-like		Not meningococcus-like					
						Typical	Atypical or doubtful	Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	
29	27.3.15	Crook Lane, Winsford	36	M.	..	–	–	..	+	..	..	..	*
46	9.4.15	4, Newfield, Lymm..	34	M.	45	–	–	+	+	..	..	Small B.	45*
92	29.4.15	The Bank, Scholar Green, Congleton	6	M.	..	–	–	..	+	+	..	..	*
99	29.4.15	Children's Hospital, Pendlebury, 14, Redford Street, C.-on-M.	1	F.	..	–	+	..	..	..	..	Large B.	*
104	5.5.15	Children's Hospital, Pendlebury	10	M.	..	–	–	+	..	..	..	Short B.	*
106	7.5.15	Blackburn Road, Darwen	6	M.	..	–	–	..	+	..	..	..	*
116	12·5.15	2, Queen's Road, W., Didsbury	2	M.	117	–	+	..	+	..	..	..	117*
150	26.5.15	Moss Side Hospital, Lytham	7	F.	120	–	–	+	+	..	..	Small B.	111, 120*
159	31.5.15	Monsall Hospital, Manchester	17	F.	70	–	–	+	+	..	..	..	70*
160	31.5.15	7, Darwen St., Weaste, Ladywell, San.	18	M.	160	–	–	+	+	..	..	..	*
203	15.6.15	St. Joseph's Industrial School, Manchester	12	M.	..	–	–	+	..	..	..	..	*
204	15.6.15	St. Joseph's Industrial School, Manchester	12	M.	..	–	–	+	..	..	..	..	*
255	21.7.15	14, Walker Street, Openshaw	$\frac{4}{12}$	F.	253	–	–	..	+	..	+	..	253*

C.S.F. Ref. No.

Notes relating to Cases in Table B (2).

29 Probably negative. Pneumonia.
46 No information received.
92 Negative case. Probably pneumonia.
99 Doubtful case. Meningitis—nature doubtful.
104 Probably not cerebrospinal fever.
106 Probably not cerebrospinal fever.
116 Negative case.
150 Doubtful case. Probably not cerebrospinal fever.
159 Cerebrospinal fever positive April, 1915. Convalescent.
160 Probably not cerebrospinal fever.
203 Pneumonia.
204 Pneumonia.
255 Cerebrospinal fever positive.

C.—Results of the Examination of Swabbings from the Nasopharynx of Contact Cases.

(1) *Military Cases.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Reference No. of primary case	Cultivation at 37° C. on Glucose P.B. Serum — Growth — Meningococcus-like: Typical	Atypical or doubtful	Not meningococcus-like: Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	Reference to notes*
32	3.4.15	2nd W., Whitworth Street, Manchester	45	F.	31	–	–	..	No notes			..	*
33	3.4.15	,, ,,	27	F.	31	–	–	..		,,		..	*
34	3.4.15	,, ,,	33	F.	31	–	–	..		,,		..	*
35	3.4.15	,, ,,	23	M.	31	–	–	..		,,		..	*
36	3.4.15	,, ,,	18	M.	31	–	+	..	..	..	..	– Gram diplococci	*
37	3.4.15	,, ,,	22	M.	31	–	–	..	..	+	..	..	*
38	3.4.15	,, ,,	33	F.	31	–	–	+	..	..	..	..	*
39	3.4.15	,, ,,	31	M.	31	–	+	..	..	..	..	Diplococci	*
40	4.4.15	,, ,,	34	M.	31	–	+	..	..	..	..	,,	*
41	4.4.15	,, ,,	19	M.	31	–	+	..	..	..	..	,,	*
42	4.4.15	,, ,,	..	..	31	–	–	..	No notes			..	*
47	9.4.15	76, Peter St., Blackburn	18	M.	..	–	+	..	..	..	..	..	*
48	9.4.15	70, Smithies Street, Blackburn	5	F.	..	–	+	..	..	..	..	..	*
49	9.4.15	37, Canning Street, Blackburn	19	M.	..	–	+	..	+	+	..	..	*
60	12.4.15	24, Marple Street, Openshaw	53	F.	59	–	+	..	+				
64	13.4.15	,, ,,	..	F.	59	–	–	+	..	+	..	Small B.	
65	13.4.14	,, ,,	..	F.	59	–	–	+	..	+			
66	13.4.14	,, ,,	..	F.	59	–	–	+	..	+	..	Large B. Diphtheroid B.	
71	14.4.15	27, Penny St., Salford	..	M.	..	–	–	..	..	+	..	Large B.	*
100	1.5.15	..	..	M.	..	–	–	..	..	+	..	Small B.	*
105	5.5.15	21, Chilworth Street, Rusholme	30	M.	103	–	–	+	..	+	..	..	*
137	22.5.15	Chadderton Camp, Oldham	20	M.	134	–	+	..	..	+	..	..	*
138	22.5.15	,, ,,	22	M.	134	–	+	..	+	+	..	..	*
139	22.5.15	,, ,,	26	M.	134	–	+	..	..	+	..	..	*
140	22.5.15	,, ,,	35	M.	134	–	–	..	..	+	..	+ Gram diplococci	*
141	22.5.15	,, ,,	36	M.	134	–	–	..	..	+	..	..	*
142	22.5.15	,, ,,	19	M.	134	–	–	..	+	+	..	..	*
143	22.5.15	,, ,,	29	M.	134	–	+	..	+	+	..	..	*
144	22.5.15	,, ,,	30	M.	134	–	–	..	+	+	..	..	*
145	22.5.15	,, ,,	21	M.	134	–	+	..	+	+	..	..	*
149	22.5.15	,, ,,	33	M.	134	–	–	..	..	+	..	..	*
155	28.5.15	7, Darwen Street, Weaste	..	M.	160	–	–	+	+	+	..	Large B.	*
161	27.5.15	2nd W., Whitworth Street, Manchester	..	F.	158	–	–	..	..	..	..	..	*

C.—Results of the Examination of Swabbings—*continued*.

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Reference No. of primary case	Cultivation at 37° C. on Glucose P.B. Serum — Growth — Meningococcus-like: Typical	Meningococcus-like: Atypical or doubtful	Not meningococcus-like: Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	Reference to notes *
162	27.5.15	2nd W., Whitworth St., Manchester	..	F.	158	–	–	..	..	..	..	..	*
163	27.5.15	,, ,,	..	F.	158	–	–	..	..	..	..	..	*
164	27.5.15	,, ,,	..	M.	158	–	–	..	..	..	..	..	*
165	27.5.15	,, ,,	..	M.	158	–	–	..	..	..	..	..	*
166	27.5.15	,, ,,	..	M.	158	–	–	..	..	..	..	..	*
167	27.5.15	,, ,,	..	M.	158	–	–	..	..	..	..	..	*
168	27.5.15	,, ,,	..	M.	158	–	–	..	..	..	..	..	*
169	27.5.15	,, ,,	..	M.	158	–	–	..	..	..	..	..	*
181	8.6.15	Ancoats Hospital, Manchester	23	M.	180	–	–	+	..	+	..	Diplococci in chains, sarcinæ	*
182	8.6.15	,, ,,	24	M.	180	–	–	+	+	..	..	..	*
183	8.6.15	,, ,,	26	F.	180	–	–	+	+	+	..	Thick B. Small B.	*
184	8.6.15	,, ,,	28	F.	180	–	–	+	+	+	..	Yeasts, Small B.	*
185	8.6.15	,, ,,	..	F.	180	–	–	..	..	+	..	Yeasts	*
186	8.6.15	,, ,,	22	M.	180	–	–	..	+	+	..	Diplococci in chains	*
194	14.6.15	Cecil Road Hospital, Hale	25	F.	193	–	–	+	..	..	..	Large B.	*
195	14.6.15	,, ,,	35	F.	193	–	–	+	..	+	..	..	*
196	14.6.15	,, ,,	23	F.	193	–	–	+	+	+	..	..	*
197	14.6.15	,, ,,	27	F.	193	–	–	..	+				
198	14.6.15	,, ,,	30	F.	193	–	–	..	+	+	..	Large diplococci	
199	14.6.15	,, ,,	22	F.	193	–	–	+	+	+			
200	14.6.15	,, ,,	36	F.	193	–	–	+	..	+	..	Large coccus in chains and pairs	
201	14.6.15	,, ,,	47	F.	193	–	–	+	+	+			

Notes relating to Cases in Table C (1).

C.S.F. Ref. No.	
32-42	Contacts with positive primary case.
47-49	Contacts with primary positive case.
71	Contact (remote) of positive primary case.
100	Contact with positive primary case (three months previously).
105	Contact with doubtful positive primary case.
137-145 and 149	Contacts with negative primary case. Tubercular.
155	Contact with a primary case—probably negative.
161-169	Contact with positive primary case.
181-186	Contact with negative primary case. (Streptococcus—cerebral abscess).
194-201	Contact with negative primary case.

C.—Results of the Examination of Swabbings from the Nasopharynx of Contact Cases.

(2) *Civil Cases.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Reference No. of primary case	Cultivation at 37° C. on Glucose P.B. Serum — Growth — Meningococcus-like — Typical	Atypical or doubtful	Not meningococcus-like — Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	Reference to notes*
10	17.8.15	6, Thompson Street, Strangeways, Manchester	30	F.	9	–	–	+	+	+	..	Large and small B.	*
11	17.3.15	,, ,,	35	M.	9	–	–	+	+	+	..	Large B.	*
12	17.3.15	,, ,,	3	M.	9	–	–	+	+	+	..	..	*
13	17.3.15	,, ,,	5	F.	9	–	–	+	+	+	..	Small B.	*
50	9.4.15	34, Boothley Road, Blackpool	40	F.	..	–	–	..	+	..	..	..	*
51	9.4.15	104, Coronation St., Blackpool	53	F.	..	–	–	..	+	..	..	..	*
52	9.4.15	,, ,,	53	M.	..	–	–	..	+	..	..	..	*
53	9.4.15	34, Boothley Road, Blackpool	36	M.	..	–	–	..	+	..	..	..	*
54	9.4.15	,, ,,	4	F.	..	–	–	..	+	..	..	..	*
55	9.4.15	184, Thornton Road, Moss Side, Manchester	1	M.	..	–	–	..	+	..	..	..	*
56	9.4.15	,, ,,	..	F.	..	–	–	..	+	..	..	..	*
62	13.4.15	..	..	M.	..	–	–	..	+	+	..	Small B.	*
63	13.4.15	..	..	F.	..	–	–	+	..	..	..	Small B.	*
67	13·4.15	..	..	M.	..	–	–	..	+	+	..	..	*
68	13.4.15	..	..	F.	..	–	–	+	+	..	..	..	*
69	13.4.15	..	..	F.	..	–	–	+	+	..	..	..	*
72	14.4.15	15, Matlock Street, Manchester	60	M.	..	–	–	+	+	+	..	Small B.	*
73	14.4.15	,, ,,	50	F.	..	–	–	+	..	+	..	Slender B.	*
74	14.4.15	,, ,,	34	M.	..	–	–	+	+	..	..	Yeasts Slender B.	*
75	14.4.15	,, ,,	20	M.	..	–	–	+	+	..	..	Thick B. Slender B.	*
77	19.4.15	18, Hemmons Road, Gorton, Manchester	34	F.	..	–	–	+	+	+	..	Lanceo. Bac.	*
78	19.4.15	,, ,,	11	F.	..	–	–	..	+	+	..	Slender B.	*
79	19.3.15	,, ,,	8	F.	..	–	–	+	..	+	..	Lanceo. B. Thick B.	*
80	12·4.15	40, Owen Street, Gorton, Manchester	35	F.	..	–	–	..	+	..	..	Diphtheroid B.	*
81	19.4.15	20, Hemmons Road, Gorton, Manchester	40	F.	..	–	–	+	..	..	..	..	*
84	24.4.15	Nurses'Home,Darwen	33	F.	83	–	+	..	+	..	..	Small B.	*
85	24.4.15	22, Lime Grove, Blackpool	20	F.	..	–	+	..	..	+	..	..	*
86	24.4.15	,, ,,	19	F.	..	–	+	+	+	..	..	..	*
87	24.4.15	,, ,,	47	F.	..	–	–	..	+	+	..	..	*
89	27.4.15	85, Clifton Street, Old Trafford,Manchester	..	M.	..	–	+	..	..	..	..	Large B.	*
90	27.4.15	,, ,,	..	..	..	–	+	+	+	..	..	..	*
93	29.4.15	245, Hyde Road, Gorton, Manchester	42	M.	91	–	+	..	..	..	..	..	*
94	29.4.15	,, ,,	40	F.	91	–	..	+	+	..	..	..	*
95	29.4.15	,, ,,	13	M.	91	–	+	+	..	..	..	..	*
96	29.4.15	,, ,,	7	F.	91	–	+	+	..	..	..	..	*
97	29.4.15	,, ,,	21	F.	..	–	–	+	+	..	..	..	*

C.—Results of the Examination of Swabbings—*continued.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Reference No. of primary case	Cultivation at 37° C. on Glucose P.B. Serum							Reference to notes *
						Growth							
						Meningococcus-like		Not meningococcus-like					
						Typical	Atypical or doubtful	Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	
101	3.5.15	4, Hayley St., Longsight, Manchester	35	M.	103	–	+	..	+	..	..	..	*
102	3.5.15	,, ,,	30	F.	103	--	+	+	..	..	..	..	*
107	7.5.15	1, West View, Blackpool	35	M.	..	–	–	+	+	..	..	..	*
108	7.5.15	,, ,,	$\frac{9}{12}$	F.	..	–	–	..	+	..	..	..	*
109	7.5.15	,, ,,	34	F.	..	–	+	..	..	+	..	..	*
110	7.5.15	,, ,,	10	M.	..	–	+	..	..	+	..	..	*
112	8.5.15	,, ,,	7	F.	..	–	–	..	..	+	..	..	*
114	8.5.15	,, ,,	7	M.	..	–	–	..	..	+	..	..	*
121	18.5.15	4, Hayley St., Longsight, Manchester	3	M.	103	–	–	..	..	+	..	Small B.	*
129	21.5.15	4, Siding St., Bacup	45	M.	122	–	+	..	..	+	..	..	*
130	21.5.15	,, ,,	46	F.	122	–	–	..	+	+	..	..	*
131	21.5.15	,, ,,	13	M.	122	–	+	..	+	+	..	..	*
132	21.5.15	,, ,,	18	F.	122	–	–	..	..	..	..	No growth	*
133	21.5.15	,, ,,	8	F.	122	–	–	..	+	+	..	..	*
146	24.5.15	Dales Avenue, Whitefield, Manchester	14	F.	..	–	..	+	..	+	..	Lanceo. B.	*
152	26.5.15	The Manse, Albert Road, Hyde	13	F.	..	–	–	..	+	+	..	..	*
187	11.6.15	111, Brompton Street, Oldham	27	F.	..	–	–	+	+	+	..	..	*
254	21.7.15	14, Walker Street, Manchester	32	F.	253	+	–	..	+	..	..	Curved B.	*
256	27.7.15	,, ,,	36	M.	253	–	..	..	..	..	..	..	*
257	27.7.15	,, ,,	6	M.	253	–	..	..	..	..	..	..	*
258	27.7.15	,, ,,	10	F.	253	–	..	..	..	..	..	..	*

Notes relating to Cases in Table C (2).

C.S.F. Ref. No.	
10-13	Contacts of positive primary case.
51-56	Contacts of doubtful primary case. History incomplete.
62, 63	Contacts of positive case.
67-69	Contacts of positive case. History incomplete.
72-75	Contacts of positive case. History incomplete.
77-81	Contact of doubtful positive primary case. History incomplete.
84	Contact of positive primary case.
85-87	Contact of positive primary case. History incomplete.
89, 90	Contact of negative primary case.
93-97	Contact of positive primary case.
101, 102, 121	Contacts of doubtful positive primary case.
107, 108, 109, 110, 112, 114	Contacts of doubtful positive primary case.
129-133	Contacts of positive primary case.
146	Contact of positive primary case. History incomplete.
152	Contact of positive primary case. History incomplete.
187	Contact of positive primary case. History incomplete.
254, 256, 257, 258	Contacts of positive primary case. History incomplete.

Research Series.

The material from the cases in this table (with the exception of Nos. 8 to 26) was collected by Captain Tylecote, who also selected the cases and furnished the clinical information.

D.—Results of the Examination of Swabbings from the Nasopharynx of Soldiers, healthy or affected with Various Diseases or Lesions (8 Civil Cases (16 to 26) included).

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Cultivation at 37° C. on Glucose P.B. Serum: Growth: Meningococcus-like: Typical	Meningococcus-like: Atypical or doubtful	Not meningococcus-like: Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	Reference to notes *
8	15.3.15	Clitheroe Auxiliary Hospital	..	M.	–	–	–	+	+	–	–	*
16	18.3.15	81, Sandy Lane, Lowton, Leigh	8	F.	–	–	–	+	–	–	–	*
17	18.3.15	68, Railway Road, Urmston	30	F.	–	–	..	..	+	..	..	*
18	18.3.15	6, Hopwood Avenue, Eccles	40	F.	–	–	..	..	+	..	..	*
19	18.3.15	31, Albert St., Eccles	40	F.	–	–	..	+	+	..	..	*
23	24.3.15	36, Atherton Street, Eccles	7	M.	–	–	..	+	..	+	..	*
24	24.3.15	,, ,,	5	F.	–	–	+	..	..	..	Slender B.	*
25	24.3.15	,, ,,	3	F.	–	–	..	+	..	..	..	*
26	24.3.15	,, ,,	8	M.	–	–	..	..	..	+	..	*
123	20.5.15	Nell Lane Hospital, Withington	23	M.	–	+	..	..	+	..	..	*
124	20.5.15	,, ,,	44	M.	–	–	..	+	+	..	Diplo. in very tenacious colonies	*
125	21.5.15	2nd Western Hospital, High St., Manchester	31	M.	–	+	..	+	+	..	..	*
126	21.5.15	,, ,,	26	M.	–	+	..	..	+	..	..	*
127	21.5.15	,, ,,	25	M.	–	+	..	+	+	..	..	*
128	21.5.15	,, ,,	22	M.	–	–	+	+	+	..	..	*
156	29.5.15	,, ,,	22	M.	–	–	+	+	..	..	..	*
157	29.5.15	,, ,,	30	M.	–	–	+	+	..	..	..	*
170	1.6.15	Nell Lane Hospital, Withington	24	M.	–	–	..	+	+	..	Large B.	*
171	1.6.15	,, ,,	20	M.	–	–	+	+	..	..	Small B.	*
172	1.6.15	,, ,,	21	M.	–	–	+	+	..	..	..	*
173	1.6.15	,, ,,	22	M.	–	–	+	..	..	..	Large B.	*
188	11.6.15	2nd Western Hospital, High St., Manchester	22	M.	–	–	..	+	..	..	Cocci and diplococci in short chains	*
189	11.6.15	,, ,,	22	M.	–	–	..	..	+	..	Large diplococci	*
190	11.6.15	,, ,,	23	M.	–	–	..	+	+	+	..	*
191	11.6.15	,, ,,	33	M.	–	–	+	+	+	..	Large cocci and diplococci +Gram	*
205	21.6.15	,, ,,	20	M.	–	–	+	+	..	..	..	*
206	21.6.15	,, ,,	27	M.	–	–	..	..	+	..	Large B. Diplococci	*
207	21.6.15	,, ,,	25	M.	–	–	+	+	+	..	..	*
208	21.6.15	,, ,,	24	M.	–	–	+	+	..	..	Large coccus in chains –Gram	*
211	21.6.15	,, ,,	22	M.	–	–	..	+	+	..	..	*
212	22.6.15	,, ,,	20	M.	–	–	..	+	..	..	..	*
214	28.6.15	,, ,,	21	M.	–	–	..	+	..	..	Diplococci	*

D.—Results of the Examiation of Swabbings—*continued.*

C.S.F. No.	Date	Town, district, hospital, camp	Age	Sex	Cultivation at 37° C. on Glucose P.B. Serum — Growth — Meningococcus-like: Typical	Meningococcus-like: Atypical or doubtful	Not meningococcus-like: Pneumococci	Staphylococci	Streptococci	Diphtheria B.	Various	Reference to notes *
215	28.6.15	2nd Western Hospital, High St., Manchester	25	M.	–	–	..	+	..	..	– Gram staphylococci	*
216	28.6.15	,, ,,	21	M.	–	–	..	+	..	..	– Gram staphylococci	*
217	28.6.15	,, ,,	29	M.	–	–	..	+	..	..	– Gram staphylococci	*
221	30.6.15	,, ,,	35	M	–	–	..	+	+	..	..	*
222	30.6.15	,, ,,	37	M.	–	–	+	..	..	..	Diplococci Diphtheroid B.	*
223	30.6.15	,, ,,	20	M.	–	–	+	+	+	..	Diplococci	*
224	30.6.15	,, ,,	22	M.	–	–	..	+	+	..	Diphtheroid B.	*
226	1.7.15	Nell Lane Hospital, Withington	21	M.	–	–	..	..	+	..	Large cocci in chains	*
227	1.7.15	,, ,,	..	M.	–	–	+	+	+	..	..	*
228	1.7.15	,, ,,	24	M.	–	–	..	+	..	..	Large cocci and diplococci Diphtheroid B.	*
229	1.7.15	,, ,,	20	M.	–	–	..	+	+	..	..	*
232	5.7.15	2nd W., High Street, Manchester	19	M.	–	–	+	+	+	..	..	*
233	5.7.15	,, ,,	28	M.	–	–	+	+	+	..	Diphtheroid B.	*
234	5.7.15	,, ,,	28	M.	–	–	..	..	+	..	Large B.	*
235	5.7.15	,, ,,	19	M.	–	–	..	..	+	..	Diplococci	*
236	7.7.15	,, ,,	33	M.	–	–	..	..	+	..	Diplococci Large B.	*
237	7.7.15	,, ,,	21	M.	–	–	..	..	+	..	Diplococci	*
238	7.7.15	,, ,,	37	M.	–	–	+	+	..	..	Diplococci	*
240	8.7.15	Nell Lane Hospital, Withington	23	M.	–	–	..	+	+	..	..	*
241	8.7.15	,, ,,	25	M.	–	–	+	+	..	..	..	*
242	8.7.15	,, ,,	37	M.	–	–	..	+	+	..	Large B.	*
243	8.7.15	,, ,,	24	M.	–	–	..	+	..	+	..	*
244	8.7.15	,, ,,	22	M.	–	–	..	+	..	+	Diplococci	*
245	8.7.15	,, ,,	34	M.	–	–	..	+	..	..	Diplococci, long slender B	*

Notes relating to Cases in Table D.

C.S.F. Ref. No.	
8	History of sore throat. Uticarial rash. Tonsillitis. Not cerebrospinal fever.
16	No information.
17-19	Supposed to be contacts. No information of primary case. Diagnosis unconfirmed.
23-26	Supposed to be contacts. No information of primary case. Diagnosis unconfirmed.
123-128	See special table for notes.
156, 157	,, ,, ,, ,,
170-173	,, ,, ,, ,,
188-191	,, ,, ,, ,,
205-208	,, ,, ,, ,,
211, 212	,, ,, ,, ,,
214-217	,, ,, ,, ,,
221-224	,, ,, ,, ,,
226-299	,, ,, ,, ,,
232-238	,, ,, ,, ,,
240-245	,, ,, ,, ,,

D—Results of the Examination of Swabbings—*continued.*

C.S.F. No.	State of throat	Other lesions	Notes
123	Pharynx congested	G.S. wound ..	Supposed to have been in contact with case of C.S. fever 5 weeks ago.
124	Normal throat	,, ..	..
125	,, ,, ...	,, ..	..
126	Fauces congested. Granular pharyngitis	,, ..	..
127	Fauces and pharynx congested	Inguinal hernia ..	..
128	,, ,,	Ventral hernia ..	..
156	Pharynx congested. Granular pharyngitis	G.S. wound ..	Gonorrhœa. Pus examined.
157	Throat normal	..	,, ,,
170	,, ,, ...	,, ..	..
171	Catarrhal	Sharpnel wound ..	..
172	Normal throat	G.S. wound ..	Heavy smoker.
173	Congested fauces. Slight ulceration	Shrapnel wound ..	Slight pleurisy.
188	Pharynx œdematous. Much mucus	..	Gonorrhœal epididymitis.
189	Normal throat	..	Epididymitis. Soft sore bubo.
190	Congested pharynx	..	Acute rheumatism.
191	Follicular tonsillitis. Pharynx congested	..	..
205	Normal throat	..	Gonorrhœa.
206	,, ,, ...	..	Gonorrhœa. Pus examined. Culture under observation 72 hours.
207	,, ,, ...	..	Gonorrhœa. Culture kept 72 hours.
208	,, ,, ...	..	Culture kept 72 hours. Gonorrhœa pus examined.
211	,, ,, ...	..	Gonorrhœa. Pus examined.
212	,, ,, ...	..	,, ,,
214	Normal	Varicose veins ..	..
215	,, ...	G.S. wound. Fractured femur	..
216	,, ...	G.S. wound ..	..
217	,, ...	,, ..	..
221	,, ...	G.S. wound. Influenza	..
222	,, ...	Influenza	..
223	,, ...	Cardiac disease ..	..
224	,, ...	Renal colic ..	..
226	Recovering from tonsillitis ..	..	..
227	Follicular tonsillitis	..	..
228	Congested	Bronchitis ..	..
229	Normal	Fractured patella. Alveolar abscess	..
232	,, ...	Syphilis	..
233	Slight tonsillitis. Specific ulcers on soft palate	,, ...	..
234	Normal	,, ...	..
235	,, ...	Gonorrhœal warts ..	..
236	Soft palate congested ..	Gas poisoning ..	..
237	Chronic rhinitis	..	..
238	Pharynx and soft palate intensely red	Acute laryngitis ..	..
240	Ulcer on left tonsil	Epilepsy	..
241	Normal	Shrapnel wound ..	..
242	Pharynx congested	Eczema, face. Hæmorrhoids	..
243	Normal	G.S. wound ..	..
244	,, ...	Dental caries. Hernia	..
245	,, ...	Nephritis	..

E.—Results of the Tests to which Meningococcus-like Organisms have been submitted.

(1) *Military Cases.*

C.S.F. No.	Date	Source of material	Colonies on glucose P.B. serum	Growth at		Fermentation of		
				37° C.	23° C.	Glucose	Maltose	Saccharose
31	1.4.15	C.S. fluid	Typical	+ +	0	+ +	+ +	0
36	3.4.15	Nasopharynx	Atypical	+ +	+ +	+ +	..	+ +
39	4.4.15	,,	,,	+ +	..	+ +	..	+ +
40	4.4.15	,,	,,	+ +	..	+ +	+ +	+ +
41	4.4.15	,,	,,	+ +	..	+ +	+ +	+ +
47	9.4.15	,,	,,	+ +	+ +	+ +	+ +	+ +
48	9.4.15	,,	,,	+ +	+ +	+ +	+ +	+ +
49	9.4.15	,,	,,	+ +	+ +	+ +	+ +	+ +
98	29.4.15	,,	,,	+ +	0 (in 6 days)	+ +	..	+ +
123	20.5.15	,,	,,	+ +	..	+ +	..	+ +
125	21.5.15	,,	,,	+ +	..	+ +	..	+ +
126	21.5.15	,,	,,	+ +	..	+ +	..	+ +
127	21.5.15	,,	,,	+ +	..	+ +	..	+ +
137	22.5.15	,,	,,	+ +	+	+ ?	..	–
138	22.5.15	,,	,,	+ +	+	+ +	..	+ +
139	22.5.15	,,	,,	+ +	..	+ +	..	+ +
143	22.5.15	,,	,,	+ +	..	+ ?	..	–
145	22.5.15	,,	,,	+ +	+	+ ?	..	–
192	14.6.15	,,	,,		+	+ +	..	+ +

(2) *Civil Cases.*

C.S.F. No.	Date	Source of material	Colonies on glucose P.B. serum	Growth at 37° C.	Growth at 23° C.	Glucose	Maltose	Saccharose
9	16.3.15	C.S. fluid	Typical	+ +	..	+ +	+ +	0
60	12.4.15	Nasopharynx	Atypical	+ +	+ +	+ +	0	0
70	14.4.15	C.S. fluid	Typical	+ +	0	+ +	+ +	0
82	20.4.15	,,	,,	+ +	0	+ +	..	0
83	24.4.15	,,	Specimen collected twenty-four hours after death. Cultures contaminated.					
84	24.4.14	Nasopharynx	Atypical	+ +	..	0	..	0
85	24.4.14	,,	,,	+ +	..	+ +	..	+
86	24.4.14	,,	,,	+ +	..	+ +	..	+ +
89	27.4.15	,,	,,	..	..	+ ?	..	+ +
90	27.4.15	,,	,,	+ +	+ +	+ +	..	+ +
91	28.4.15	C.S. fluid	Typical	+ +	0	+ +	..	0
93	29.4.15	Nasopharynx	Atypical	+ +	0	+ +	..	+ +
95	29.4.15	,,	,,	+ +	+ +	+ +	..	+ +
96	29.4.15	,,	,,	+ +	+ +	+ +	..	+ +
99	29.4.15	,,	,,	+ +	..	+ +	..	+ +
101	3.5.15	,,	,,	+ +	..	+ +	..	+ +
102	3.5.15	,,	,,	+ +	+ +	+ +	..	–
103	3.5.15	C.S. fluid	,,	+ +	+ +	+ +	..	+ +
109	7.5.15	Nasopharynx	,,	+ +	..	+ +	..	+ +
110	7.5.15	,,	,,	+ +	..	+ +	..	+ +
116	12.5.15	,,	,,	+ +	+ +	+ +	..	+ +
118	13.5.15	C.S. fluid	Typical	+ +	0	+ +	..	0
129	21.5.15	Nasopharynx	Atypical	+ +	+ +	+ +	..	+ +
131	21.5.15	,,	,,	+ +	+	+ +	..	+ +
220	30.6.15	C.S. fluid	,,	+ +	–	+ +	+ +	–
239	8.7.15	,,	,,	+ +	+ +	+ +	+ +	–
249	11.7.15	,,	,,	+ +	+ +	+ +	+ +	–
250	13.7.15	,,	,,	+ +	+ +	+ +	+ +	+
253	20.7.15	,,	Typical	+ +	A little after 48 hrs.	+ +	+ +	–
254	21.7.15	Nasopharynx	,,	+ +	–	+ +	+ +	–

FURTHER NOTES ON THE RAPID PREPARATION OF HIGH TITRE AGGLUTINATING SERUM FOR MENINGOCOCCUS.

By Captain T. G. M. HINE.
Royal Army Medical Corps.

In the October number of this Journal a preliminary note was published on the method of rapidly obtaining a serum agglutinating the meningococcus, of a titre sufficiently high for test purposes; the same investigation is here carried a step further.

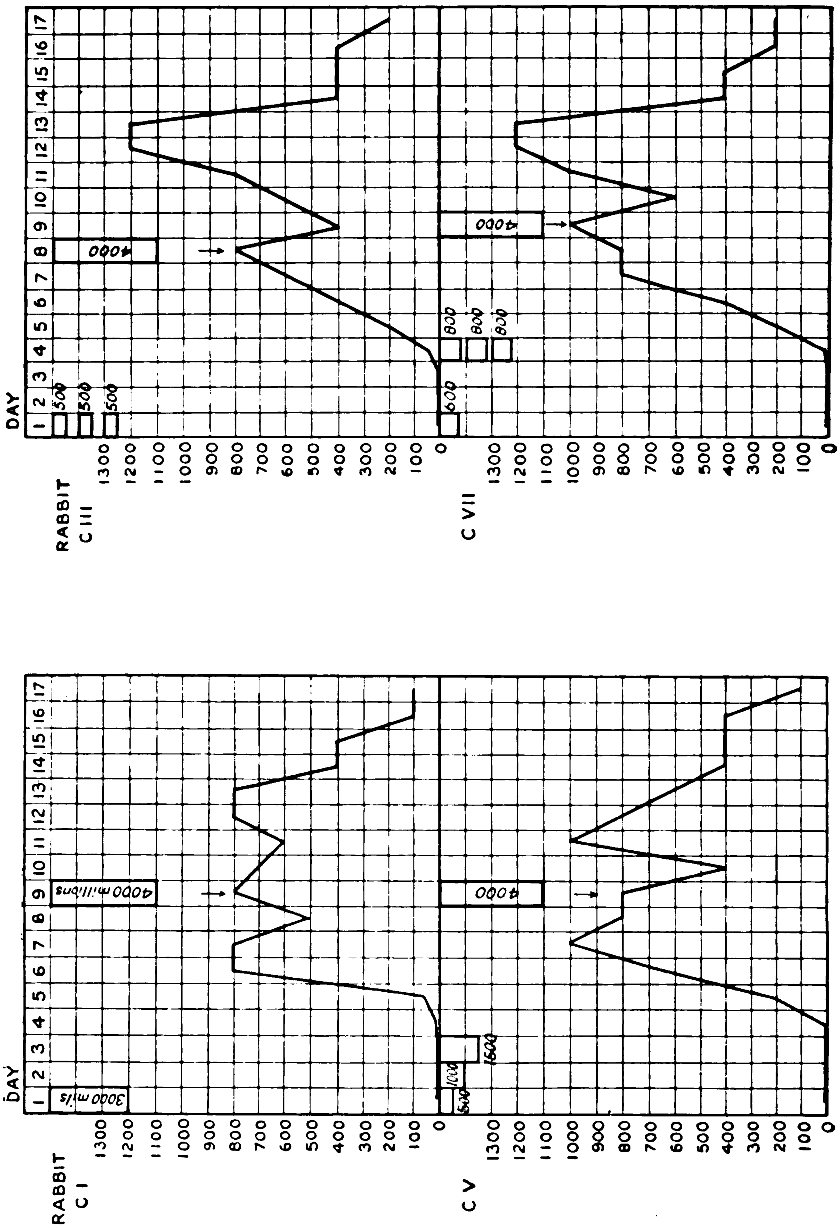
Although the titre of 1 in 800 obtained in eight days in the preceding Series B was sufficiently high and speedy to be of use for agglutination reactions, it was thought that the method might be improved, and a better serum obtained by a further injection without the loss of much more time. Accordingly, after some further tests with the rabbits of Series B, in which some of the sera attained a titre of 1 in 1,200 on the twenty-fifth day, the following experiments were carried out.

Four rabbits, of about 1,300 grammes each, were injected, as in Series B, with a standard suspension of the same coccus type II, freshly made; the total dose being again 3,000 millions. It was intended to give them a further single dose of 4,000 millions on the ninth day. Three of the rabbits survived; rabbit III, however was found dead about one hour after its second injection. A second rabbit was therefore procured and the first and second doses of 1,000 millions repeated; about half an hour after its second dose, however, this rabbit showed uneasiness with spasmodic kicks of its hind quarters, while its breathing became prolonged and laboured. It quickly developed an increasing paralysis of its fore-quarters and respiratory muscles, until, in about five minutes from the onset, the animal turned on its side unconscious, with no respiratory or other movements, and died, its heart continuing to beat for some three minutes after respiration had ceased.

It was obvious that the suspension used, though of the same coccus, was more toxic than that injected in Series B, and so on the third day a third rabbit was given three doses of 500 million cocci, half the former dose, at hourly intervals. This rabbit survived, though it appeared somewhat disturbed after the third dose. None of the other rabbits showed any untoward symptoms.

A sample of blood was collected every day from each rabbit as

CHART III.



before, and on the ninth morning (the eighth for rabbit III), they each received 4,000 million cocci in a single dose.

Chart III shows the agglutination curves of this experiment, and it will be seen that after a first rise similar to that in Chart II (see October number) a fall occurred—after the injection of the second dose of 4,000 millions—from a titre of 1 in 1,000 or thereabouts to about half this amount; in the case of rabbits III and VII a rise quickly followed to 1 in 1,200 on the twelfth day, while in rabbits I and V it only attained 1 in 1,000. The weights of the rabbits increased normally, though the second injection as well as the first temporarily lowered their weight by a few grammes. It thus appeared that the second dose increased the titre by fifty per cent above that in Series B within four days.

The methods of injection used with rabbit III and rabbit VII here again gave the best results. As the "rabbit III" method is a much simpler one, provided too ambitious a dose is not attempted at first, it would seem the better of these two; moreover, it should be noted that in this case rabbit III had only half the initial dose of the other rabbits, i.e., 1,500 millions as against 3,000 millions, though all received the second dose of 4,000 million cocci on the eighth or ninth day.

To determine if the period between the first and second dose could be lessened and a high titre agglutinin content attained in a still shorter time, it was decided to treat three rabbits with 1,500 millions of the same type II coccus divided into three equal doses at hourly intervals, and then to give each rabbit a further single dose of 3,000 millions; one rabbit on the fifth day, a second on the sixth, and the third on the seventh day.

One of these rabbits was so ill after its second dose that the third was not given and the animal died the same night.

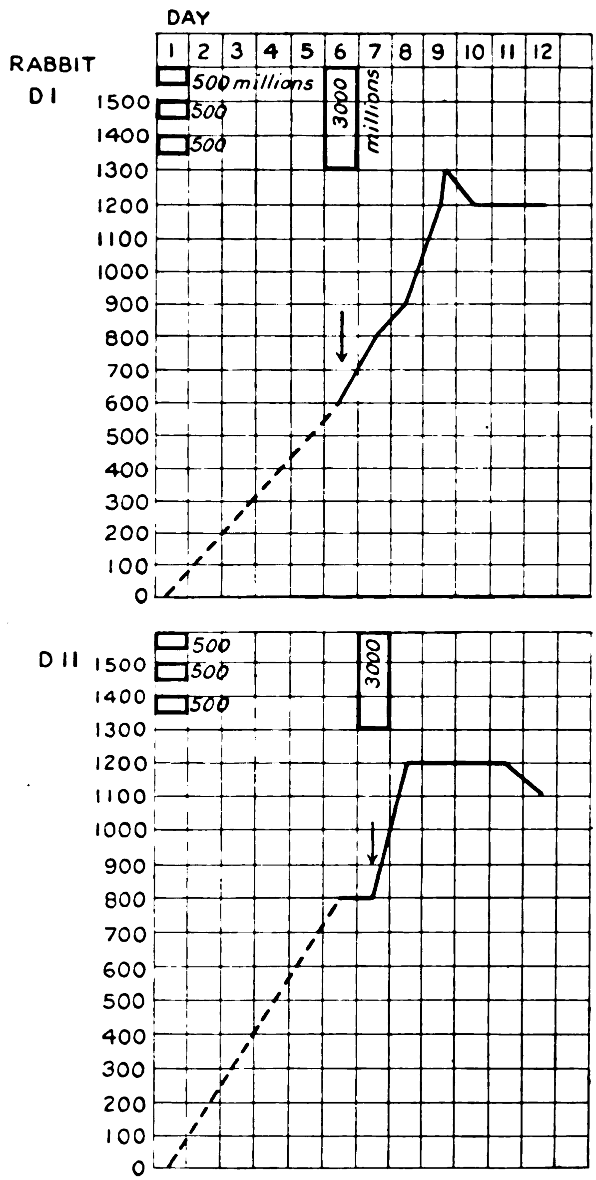
The other two rabbits had their 1,500 millions as arranged and seemed little the worse for them; one rabbit had its second dose (3,000 millions) on the sixth day, and the other on the seventh day.

A sample of blood from each rabbit was taken before the first injection and on each day from the sixth to the twelfth.

Chart IV shows the agglutination curves of this experiment as before.

In this case, the second injections being given on the rising curve did not seem to have the checking effect observed in former charts when the second dose was given at the highest point or on a descending curve. In both animals, D 1 and D 2, the agglutination titre rose to 1 in 1,200 or over on the eighth or ninth day after

CHART IV.


DAY
1 2 3 4 5 6 7 8 9 10 11 12
RABBIT
D I
500 millions
500
500
3000
millions
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
D II
500
500
500
3000

the first injection and showed a tendency to remain nearer this titre than in the previous experiments in which the titre fell very shortly after attaining its greatest height.

Conclusions.

(1) That, as regards the rapid production of agglutinin for meningococcus by the rabbit, the injection of three suitable equal doses at hourly intervals on the first day appears to be more efficacious (as far as the variations of dosage tested are concerned) than either a single one of equal total amount, or a similar dose distributed in equal or varying fractions over a period of days.

(2) That, if after an interval of five to seven days a further single injection of double the initial amount be given, a serum is obtained in a little over a week from the commencement, having as high an agglutinin content as can be desired for practical purposes. (See Chart IV.)

(3) That Gordon and Horder's observation (Report Medical Officer, Local Government Board, 1907-8, pp. 341-358) that repeated doses of meningococcus are more toxic than a single dose of an equal or larger aggregate is confirmed.

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Clinical and other Notes.

REPORT ON TRANSPORTABLE SHOWER-BATH AS USED IN —— DIVISION.

By Major P. H. HENDERSON.
Royal Army Medical Corps.

While on leave in August I obtained particulars of the above-mentioned bath, and the General Officer Commanding gave permission for the purchase of one for the washing of troops in the —— Division.

It has proved an unqualified success in every way, and is very much appreciated by officers and men.

It is of French manufacture and is extensively used in the French Army.

Cost.—The baths are made in three sizes, with 4 sprays, 6 sprays and 8 sprays, which cost, respectively, frs. 425, frs. 500, and frs. 600.

The one in use in the —— Division is of the largest type, and was purchased through the French Voluntary Aid Society, at 57, Rue Saint-Dominique, Paris.

Construction.—The apparatus consists of:—

(1) A cistern, H.
(2) A large and small iron tripod, A and B.
(3) A furnace, C, surrounded by a water-jacket or boiler, U.
(4) Spray piping, K, with eight sprays.
(5) Semi-rotary pump, M, with two lengths of hose, N and L.
(6) Foot boards, S.

The entire apparatus fits into four packing-cases, T, and is easily transportable, the total weight, including cases, being three hundred-weight.

The cistern is made of galvanized iron, about twenty-two gauge, and has a capacity of twenty-six gallons. It rests on an iron triangle, R, at a height of nine feet from the ground and is uncovered. A float pulley and lead, J, are attached to the cistern for registering the depth of the water.

The tripods are made of angle iron.

The larger tripod consists of three bars ten feet high, each folding in the middle at a lug hinge.

A triangular piece, R, fits into a mortice one inch from the top, and on this the cistern rests.

The tripod is kept in position by three round tie rods, Q, at the middle and base.

The smaller tripod is about a foot high and held together by a circular piece of angle iron on which the furnace and boiler rest.

JOUR

Di
P

T

T

T

T

The furnace is made of galvanized iron, about eighteen gauge, and has a small feeding door opening at the side. It is cone-shaped, the apex ending in a four-inch chimney.

The chimney, G, which has three movable parts fitting into one another, passes directly through the centre of the cistern, and this greatly adds to the rapidity with which the water is heated. The part of the funnel running through the cistern is fixed.

The water jacket or boiler surrounds the furnace and is fed by a three-quarter of an inch black iron flow pipe, D, which leaves the bottom of the cistern and enters the lower end of the boiler. The opening from the cistern is covered by a strainer to exclude dirt from the boiler.

A return pipe, E, similar to the above comes off from the top of the boiler and enters the cistern, opening at a height of eight inches from the bottom; this is indicated by a red mark on the outside of the cistern, and the water must never be allowed to fall below this level. A three-quarter inch black iron supply pipe, F, also leads from the top of the boiler at one side to the sprays.

This pipe is fitted with two cocks, one a shut down, P, for cutting off the sprays, and one a draw-off bib cock for emptying the cistern.

The spray delivery piping, K, is in form of a tuning-fork —⊂ and is made of half-inch black iron piping, from each arm of which four one and a quarter inch diameter sprays come off. The perforated spray caps are made of brass.

The boiler is fitted with a Centigrade thermometer, O, which registers to 100° C.

Semi-rotary Pump and Hose.—The pump is small and easily worked, requiring forty-five double strokes per minute to keep the cistern full when the bath is in constant use.

The hose-pipes are made of rubber with a canvas core.

The one-inch supply hose is ten feet long, and passes from the pump to the cistern and opens into the latter by means of a copper pipe hook which fits into the end of the hose-pipe and hooks over the edge of the cistern.

The one-inch suction hose is forty feet long and passes from the water supply to the pump. The free end in the water supply is fitted with a strainer.

The footboard battens, on which the men stand, are of the usual pattern, and consist of four large pieces and four small ones.

Method of Working the Bath.—The cistern is first filled, after which the fire is lighted, and within ten minutes the water attains a temperature of 40° C., and, with careful working, will be delivered continuously at a temperature between 37° C. and 45° C.

One man is allotted to work the pump and ensure that the cistern is kept full.

In practice it is found perfectly easy to keep the cistern full with

forty-five double strokes of the pump per minute and the expenditure of very little energy.

A second man stokes the fire, and with a little practice very quickly acquires the necessary knowledge of how to keep the water at a uniform temperature of about 40° C. with the expenditure of, on an average, forty to fifty pounds of coal a day.

The fire should never be very big, but stoked a little at a time and as often as necessary to maintain a good surface of live coal. Should the coal be of a soft nature, it is necessary to clinker about every hour.

A third man looks after the spray room and keeps it clean. He also superintends the supply of soap, &c., regulates the number of men in the spray room and prevents loitering.

Numbers Bathed.—Experience shows that working from 8 a.m. to 12 noon and from 1 p.m. to 5 p.m. six hundred men can be bathed during that time without undue pressure or crowding, and this number should not be exceeded except in an emergency, when a thousand men can be bathed in one day.

Spray Room.—The spray room should not be less than 14 feet by 14 feet, with a minimum height of 7 feet.

In summer the bath may be fixed up under a tree with a canvas screen to shut it off from public view.

An impervious floor is a great advantage but not essential.

The dressing room should communicate with the spray room and be large enough to accommodate thirty men at one time, *i.e.*, about twenty feet by twenty feet. The larger the dressing room, the greater the number of men able to be bathed.

Amount of Water Used.—The quantity of water used is about one-third of a gallon per spray per minute, so that bathing six hundred men per day of eight hours, each man uses a little over two gallons for his bath. As a rule two men prefer to go under one spray at a time as in this way they can wash each other's backs.

General Remarks.—The apparatus is extremely simple and easily worked, and with ordinary care, particularly in taking it to pieces for packing up and in putting it together, it should last for years.

It takes one hour to take it down and pack it up, and about the same time to put it together and make it ready for baths.

Advantages over Tub System of Baths.—The advantages of this shower bath are numerous and undoubted; the following being very apparent:—

(1) It is light, compact, and easily transportable.

(2) When in use it occupies very little space and can be fitted up at any place where a water supply exists.

(3) There is a great saving in water; a quarter of that used by tub system is ample, and every man gets clean water.

(4) There is less dirty water to dispose of—an important factor in flat water-logged parts of the country.

(5) The tub system requires at least eight times as much fuel for the same number of men.

(6) A great saving in soap.

(7) A great reduction in labour and in staff required to look after the baths.

Suggestions.—(1) The material of which the cistern, boiler and furnace are made should be a little thicker, to withstand wear and tear of use, also of frequent taking down and fitting up.

(2) The use of iron, lead, tin, zinc, and brass at the junctions of the pipes with the cistern is a bad combination and forms a weakness in construction.

(3) A three-quarter-inch T with a plug at the base of the flow pipe where this is connected to the boiler is very necessary to enable the boiler to be washed out.

(4) A stop-cock is required on the cross-piece of the spray delivery pipe |____ to enable the sprays on one side to be cut out when four men or under are having baths.

(5) A light cover is required for the cistern to keep out soot from the chimney and other debris.

(6) Three such spray baths should be provided for each Division and worked by P.B. men.

OBSERVATIONS ON THE DRAINAGE OF GUNSHOT WOUNDS.

By Captain C. MAX PAGE.
Royal Army Medical Corps (S.R.).

One of the features of the surgery of the present War has been the necessity for the use of some form of drainage in a large proportion of the wounds.

It must at once be admitted that the practice is undesirable. Any drain inserted into the tissues has the irritant effect of a foreign body, and in the cases in point an infective one. However, no means has yet been devised by which the evacuation of discharges and the prevention of the spread of infection can otherwise be secured. This being so, till the ideal method of treatment comes to light, one must employ the type of drain which most efficiently serves its purpose.

In civil practice, when drainage is necessary, standard rubber tubing has been commonly adopted, and in general the same material has been applied in the treatment of gunshot wounds. In this work I do not think that simple rubber tubes, either perforated or split, have proved entirely satisfactory, and I propose to describe a type of drain which, when it is a question of maintaining a wound track open in its whole

extent, appears to have certain advantages over these. It is difficult to form a judgment of such an appliance, as the standard of effectiveness does not admit of exact measurement. I will therefore merely attempt to present the reasons which suggested its design.

Principles controlling Wound Drainage.—The first action of any drain is to prevent obliteration of the cavity by adhesion or apposition of its walls. The introduction of any foreign body effects this purpose, and it is the second action, namely, the evacuation of discharges from the wound track, which determines the surgical value of any particular pattern. Supposing that no outside hydrostatic or pneumatic force be brought to bear, the movement of wound discharges is effected by two forces:—

(1) Gravity.

(2) Capillary tension.

(1) The action and value of gravity in wound drainage is so well accepted, that it need not be enlarged upon here.

(2) Capillary tension is the only force effecting drainage in the reverse direction. Its activity is directly proportionate to the capillary surface in action, and is affected by the viscidity of the fluids in question.

The co-efficient of capillarity is higher for water than for any other fluid,[1] it becomes lower in proportion to the albuminous material added.

The condition and nature of the surface dressing also control the movement of fluids in the subjacent wound—thus when the dressing is completely saturated no further movement of fluid along the capillary column abutting upon the dressing will occur.

The value of the above forces will vary in respect of different types of wound, of which three may be recognized, viz.:—

(1) A cavity, e.g., an empyema or a definitely localized abscess.

(2) A potential cavity, e.g., the track of the wound caused by a missile which has lodged.

(3) A potential tubular space, e.g., the track formed by the passage of a missile through the substance of a limb.

The method by which drainage is effected in these three types may now be considered.

(1) In the case of a cavity, the volume of fluid to be removed will be relatively large, and the drainage of the track from the surface will be usually of little importance. Under these circumstances a simple tube placed so as to reach the inner surface of the cavity will, if acting in the direction of gravity, give ideal results.

(2) In the case of a blind track there may be a foreign body or dead material at the end which cannot be completely removed, and as far as the drainage of this part is concerned the above considerations hold good. Drainage of the track however is also probably necessary and the observations made below on the third type of wound will then apply.

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[1] Magnus, "Hydrostatics and Pneumatics," p. 89. 1909.

(3) The track formed by the passage of a missile will contain blood clots and debris, the collapse of its walls will in most cases obliterate the cavity. The injury will have opened up a series of connective tissue planes, and the aim of drainage is to prevent the spread of infection along them. As the exact position of the openings of these places cannot be determined, the ideal drain should evacuate discharges from the entire inner surface of the wound track. Thus a simple tube lying in the track will permit discharge in the capillary space between its outer surface and that of the wound track; but when, as rapidly occurs, this space becomes clogged by clots or the viscidity of the discharge, the movement will cease. In this instance the action of gravity is acting at a disadvantage in the small capillary surface.

If a rubber tube with side holes be used, its action will not be very different. The perforations are rapidly filled in with granulations and intruded tissue. The discharge which there may be in the direction of gravity from the lumen of the tube will come from these buds of half strangulated tissue, and satisfactory drainage from the connective tissue planes is impossible. The same observation holds in relation to a perforated metal or glass tube.

A gauze wick acts ideally for a time, but it becomes so rapidly saturated and put out of action that it is of no value in practice.

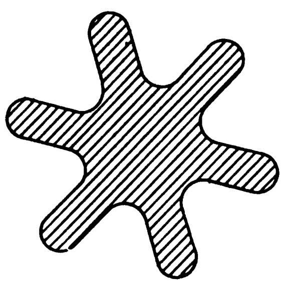


FIG. 1.—Section of gutter drain.

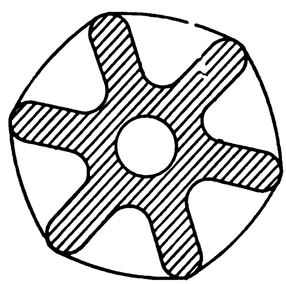


FIG. 2.—Section of gutter drain with a central lumen. Section also shows the cap.

In general it will be admitted that drainage is rapidly inhibited in all wound tracks, whether a drain is inserted or not, either by the clotting of the discharges or by the obstructive action of the surrounding tissues. The aim must therefore be to overcome this tendency to stagnation. The hypertonic saline advocated by Sir A. Wright induces a fluid discharge which does not clot. Its use therefore facilitates as well as increases wound discharge. But to obtain the best results this solution must be brought into contact with the entire surface of the wound either by continuous irrigation or by frequently repeated lavage.

The above-mentioned types of drainage tube do not allow this purpose to be fully effected, but I think the form I describe below fulfils this requirement, and also increases the capillary drainage surface in action.

The Gutter Drain.—The tube should be made of rubber. In section it is star or pinion shaped (fig. 1); the outside diameter should be the same as that of a full-sized ordinary drainage tube. For certain cases the drain should be provided with a central lumen (fig. 2).

The tube is passed through the entire length of the wound track, the upper projecting extremity is capped by a piece of thin rubber tubing (e.g., a cut rubber glove finger) which extends just into the entry of the wound (shown in fig. 2).

It will be seen that, as a result, a series of gutters lying against the wound surface extend the length of the track. When fluid is syringed into the cap, it passes down each gutter so as to bring the solution into contact with practically the whole wound surface, and at the same time clearing away from the same area all debris. After lavage the maximum capillary surface in proportion to the size of the drain is in action.

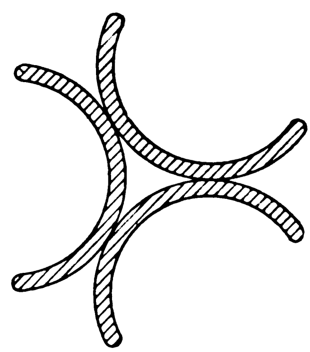


FIG. 3.—Gutter drain extemporized from sections of ordinary rubber tubing sewn together centrally. The cap is not shown.

When this type of tube is employed for blind wounds (type 2) the provision of a central lumen (fig. 2) allows the fluid to be syringed to the bottom of the track, whence it will return along the various gutters.

Theoretically it might be expected that this drain would give good results with continuous irrigation, but in practice relatively forceful washing out of the gutters periodically has proved more satisfactory.

It has not been possible to obtain drains quite in the form depicted, but I have for some months used a substitute made from ordinary rubber tubing. The tube is halved longitudinally, three lengths are then lightly sewn together to form the drain. It is capped as described above.

The appearance of a section is shown in (fig. 3).

As stated above, whatever drain is put in the tissues the reactionary

tissue formation round it socn leaves only a capillary space between the wound surface and drain; for this reason, if it is necessary to leave the drain in place for more than a few days, in addition to lavage periodical movement of the drain of the gutter type is desirable.

In conclusion it should be repeated that the above drain has only been used in its extemporized form. It is not suggested that it affords an ideal method of wound treatment, but in two respects it appears to be an improvement on the patterns in common use, viz.:—

(1) The drain forms with the surface of the wound track in proportion to its diameter the maximum capillary space, along which the evacuation of fluids can occur.

(2) It admits of lotions being brought into general contact with the surface of the wound track while the drain is in place.

A CASE OF ŒSOPHAGOTOMY FOR FOREIGN BODY.

By Captain J. H. M. FROBISHER.

Royal Army Medical Corps.

The following case is sufficiently uncommon in the Service to be worth publishing:—

Dr. Y., 1/4th Hants Battery, was admitted to the Station Hospital, Kasauli, from Lahore. His history is as follows: He was wakened one night by a sudden attack of choking, and found that he had partially swallowed an upper broken tooth-plate he was wearing. He could not swallow the plate completely. He was taken to the Station Hospital, where nothing could be found in the pharynx under chloroform. He was therefore transferred to Ambala for X rays. Here a skiagram showed the plate impacted in the gullet at the level of the cricoid cartilage. He was transferred to Kasauli for operation. On arrival here (four days after the accident) he was in great pain, very short of breath, and was coughing up a large quantity of purulent material. Œsophagotomy was decided on after examination, as nothing could be felt by the mouth.

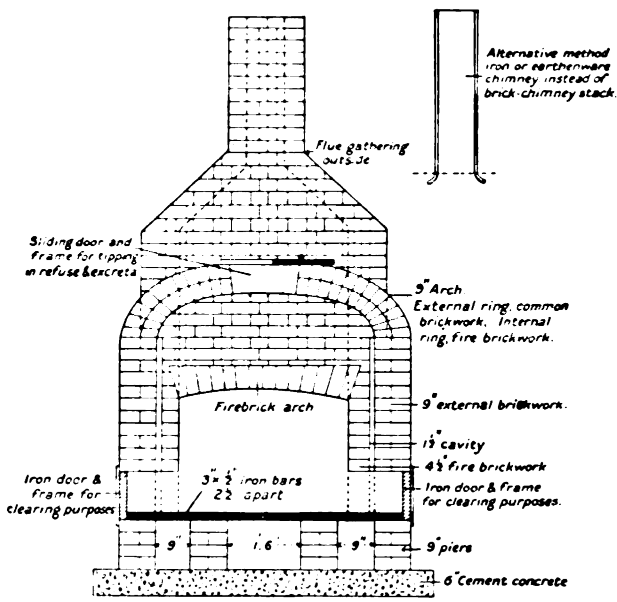
Operation.—The œsophagus was exposed on the left side of the neck through an incision along the anterior border of the sternomastoid. The carotid sheath was exposed, and dissection carried on between it and the thyroid body. The omo-hyoid required division before this could be done. The inferior thyroid artery also required ligaturing. The œsophagus was exposed, and the plate could be felt in it, and was removed through an incision in its wall. The incision in the œsophagus was closed with silk sutures, and a gauze drain put down to it. The remainder of the wound was closed, except at the lower end, where the gauze drain came to the surface.

After-history.—The patient was fed on nutrients for two days by the rectum. A large quantity of purulent material came from the drain for a week, and then gradually stopped. At the end of three days the stomach tube was passed three times a day, and the patient fed with milk and eggs. After ten days the patient was allowed pounded chicken, the wound by this time being healed except for a small sinus, which was rapidly closing. The stitches were removed on the tenth day and the gauze drain on the eighth day. Patient was put on ordinary diet a few days later. Deglutition is now perfect, and there are no signs of any trouble of any kind. The patient was sent back to Lahore.

A DESIGN FOR A BRICK DESTRUCTOR FOR THE INCINERATION OF EXCRETA AND REFUSE FROM CAMPS AND TEMPORARY HOSPITALS.

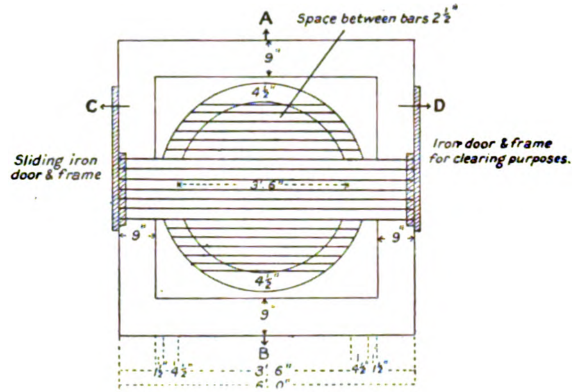
By Serjeant-Major E. B. DEWBERRY.
Royal Army Medical Corps.

The construction of the incinerator is clearly shown in the sketches. It will be noticed that the outstanding features are: The interior lining

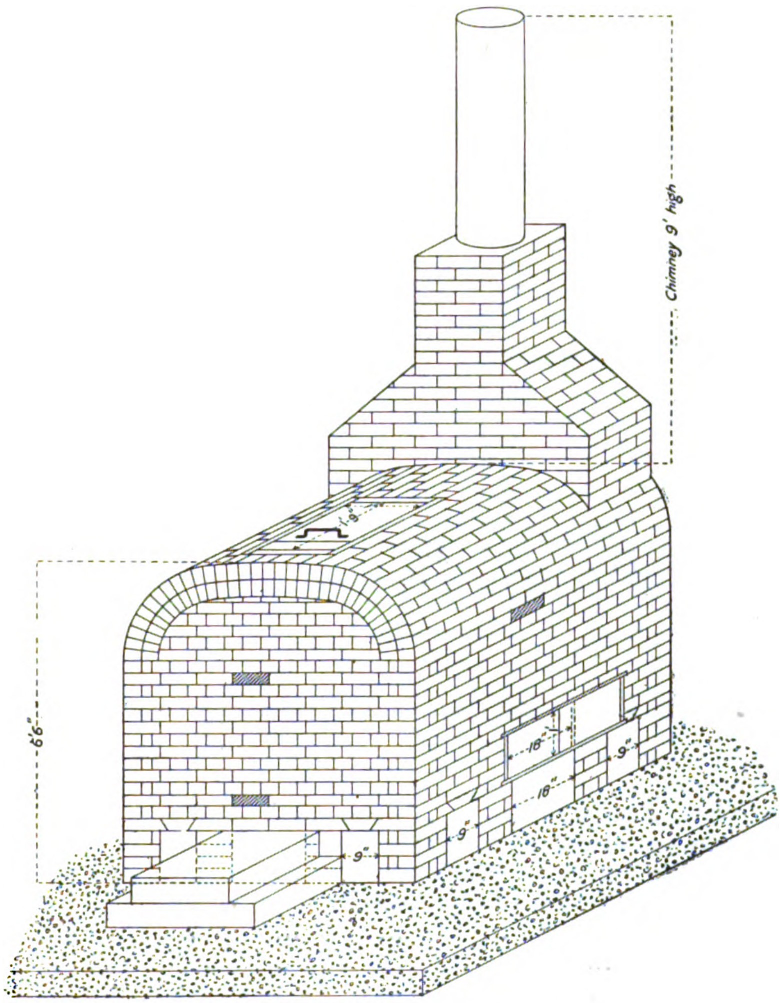


Section on line C—D.

is entirely constructed of fire-bricks, is circular, thus avoiding any accumulation of unburnt refuse in corners. An air space of one and a half inches divides the inner lining from the outer wall, air bricks being inserted

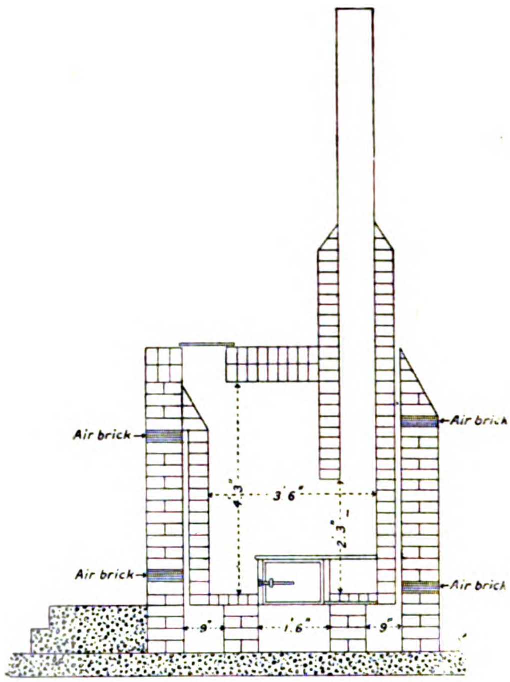


Plan.



Perspective Elevation of Brick Destructor.

in the outer wall to allow a current of air to pass through and prevent, as far as possible, the outer common bricks becoming too hot and liable to crack. There are three sliding iron doors; hinges have been avoided, as from experience they have been found quite unsuitable. The door through which the material to be burned is deposited is at the top of incinerator, two other doors being provided near the base, just above the bars, for raking out.



Section on line A—B.

Materials Required to Build Destructor.

Common bricks, 9 inches by 3 inches	1,500
Fire bricks	400
Iron sliding doors with frames	3
Air bricks, terra-cotta, 9 inches by 3 inches	8
Iron for bars, 3 inches by ½ inch	70 feet
Iron chimney, diameter 1 foot 9 inches, height 9 feet ...	1
Washed sharp sand	½ load
Cement	½ bag
Fire clay	2 sacks

If a brick chimney is to be built instead of erecting an iron one, an additional two hundred common bricks will be required. Lime mortar is preferable to cement mortar in building the destructor.

Approximate cost, £5.

Reviews.

MANUAL OF SURGERY. By Professor Alexis Thomson, F.R.C.S., and Mr. Alexander Miles, F.R.C.S. London: H. Frowde, Hodder and Stoughton, 1915. Pp. xix and 801. Fifth edition. Price 10s. 6d.

We welcome a fifth edition of this well-known and excellent Manual of Surgery, which has been completely revised; various sections have been completely rewritten in order to include the most recent advances in pathology and treatment, and many new illustrations have been added.

We are glad to see that the Basle anatomical nomenclature has been adopted, with the old system in brackets; this is both useful to the qualified man, that he may familiarize himself with it, and to the student that he may continue as he has learnt.

This text-book can be thoroughly recommended in that it gives a thorough groundwork and all that is latest in modern surgery, while dispensing with all debatable points.

We must congratulate Professor Alexis Thomson and Mr. Miles on their fifth edition, and the publishers on the handy size of the volume, and that the paper on which they are printed is not shiny and therefore dazzling by artificial light. These are minor points but of great importance to the student.

ABDOMINAL INJURIES. By Professor Rutherford Morison, F.R.C.S.Eng., and Lieutenant-Colonel W. G. Richardson, M.B., F.R.C.S. London: Frowde, Hodder and Stoughton, 1915. Pp. 116. This book belongs to the series of "Oxford War Primers."

Regarding it, unqualified approval must be expressed. It is a handy little manual of about 100 pages, each of which is crammed with surgical truth of startling quality. A perusal of the book leaves one amazed at the thoroughness of the work, both as regards the multiplicity of subjects considered and the complete consideration of each. In dealing with such a subject as abdominal surgery, it is often impossible to avoid controversial material; no hint of this, however, is seen in this volume, every point is dealt with in a spirit of confidence, which cannot fail to be appreciated by the surgeon whose experience has not enabled him to form equally definite opinions in some other direction. It is emphatically a book for those who are "looking for a lead" in abdominal work.

An outline of the plan of the book may help in demonstrating its scope. Introductory chapters on diagnosis, physical signs and methods of examination are followed by a valuable account of abdominal

contusions. Next, abdominal wounds are dealt with under the sub-headings of penetrating and perforating wounds. General considerations regarding abdominal operations are then discussed, a few pages being devoted to the treatment of hæmorrhage, and of perforation. Of exceeding value are the remarks on after-treatment of operation cases, a domain unfortunately not so generally well known as its importance merits. Complications following operation, including hæmorrhage, peritonitis, pneumonia, intestinal obstruction, are shortly descanted upon, then follow descriptions of methods to be employed in dealing with such problems as injuries to the viscera. The directions given are clear, concise, and above all suggestive of principles involved, rather than detailed, exhaustive, dealing with minutiæ.

A guiding principle insisted on in dealing with abdominal wounds is that the surgeon should look and see, rather than wait and see. This is specially important in view of the frequency with which "dirt and foreign bodies may lie hidden in the depths of a wound." In this connexion considerable stress is laid upon a "surgical rule to the effect that every perforating abdominal injury should be operated upon without delay." The experience of the military surgeon in South Africa is referred to, many cases of perforating abdominal wounds during the Boer War recovering without operation. "At the present time these war statistics may be offered as an excuse—but not as a reason—for 'expectancy!'" At the same time it is insisted on that "abdominal operations are unjustifiable except in properly organized and equipped hospitals." A further note of warning is conveyed in the sentence, "If a surgical rule were made that only bullets near the surface, and easy of access, should be removed unless they were obviously producing serious trouble, it would be of considerable advantage to our sailors and soldiers. In the abdomen, no time should be wasted in searching for them, and only those within easy and safe reach should be touched." Another important point insisted on with regard to bullet wounds is that "in the case of the hollow viscera, the rule is that both walls are involved. . . . Forgetting this has cost many lives." The weighty simplicity of this should be obvious to everyone who has repaired a punctured tyre.

For preparation of the skin of the patient five per cent carbolic acid is recommended instead of the fashionable iodine; and smooth gloves are preferred to the "non-slip" variety, chiefly on grounds of cleanliness.

In the treatment of shock "with pulse-rate above, or blood-pressure below 100," saline infusion, intravenous or hypodermic, is recommended. Curiously, though "hypodermoclysis" receives the authors' benediction, proctoclysis—a method at least as reliable—is ignored.

Worthy of note is an ingenious application of the Murphy button to lateral, or—in the case of duodenum to jejunum—end to side anastomosis, a procedure having advantages over the end to end junction for which the apparatus was devised. It would almost seem, however, that the occasions on which such a method is preferable to ordinary suture must be very exceptional, if, indeed, they exist at all.

It only remains to say that the size of the book is convenient, the paper, printing and binding of excellent quality, and the production as a whole one on which the authors, the publishers, and the purchaser are alike to be congratulated.

WOUNDS IN WAR, THEIR TREATMENT AND RESULTS. By D'Arcy Power, M.B., F.R.C.S.Eng. London: Henry Frowde, Hodder and Stoughton, 1915. Pp. 108. Price 2s. 6d. net.

This book is also one of the series of Oxford War Primers. It is a general survey of the subject of gun-shot wounds, taking up seriatim the questions of their causation, their immediate treatment on, or in close proximity to the battlefield, and their further treatment at a general hospital. Since the great majority of the wounds received in the present war become septic, the subject of suppuration is somewhat fully dealt with; there is, in addition, a chapter on Vaccine Therapy from the pen of Mr. R. L. Mackenzie Wallis. The section devoted to the results of wounds concerns itself mainly with hæmorrhage, directions being given for ligature of the more important arteries. A few pages are devoted to the subjects of tetanus and gas gangrene, the book concluding with a few general remarks on amputations.

The volume is one which should prove useful to the many men who, by the exigencies of the war, find themselves confronted with surgical problems of a kind not usually dealt with by them in times of peace. It is essentially practical in its scope, and aims always at giving precise instructions as to what to do, with just so much theory as supplies a groundwork for these instructions, rather than at academic presentation of any of the numerous surgical problems created by the war. There is little in the work of an exclusively military character; the principles adhered to throughout are those of civil surgery, though, naturally, the material dealt with is almost wholly the suppurating wound.

The letterpress and proof-reading are excellent, "well-know" for "well-known" on p. 12 is one of the few printer's errors that have escaped correction, as is the position of the second bracket enclosing the words "anterior tibial" on p. 84.

One may doubt the wisdom of introducing B.N.A. terminology into a book designed to appeal chiefly to those who have received their anatomical training in terms of the old nomenclature. In most cases, the old names are given in brackets after the new, but as this rule is not invariably followed, such phrases as the "transversus cervicis" and "transverse scapular" arteries are apt to puzzle the practitioner whose anatomical education dates back more than a year or two. Further examples of this are found in references to the "medial cutaneous nerve of the arm" and the "medial cutaneous nerve of the forearm," under which guise are revealed—or partially concealed—the lesser internal cutaneous, and internal cutaneous nerves of the upper limb.

A notable defect is the total omission of all reference to the use of hypochlorous acid, in the form of eusol, eupad, or otherwise. This substance—essentially an offspring of the present war—has already proved its valuable qualities.

Further stress might have been laid upon the method of circular amputation which leaves a raw surface on the stump, no attempt at suture being made, and one might query the truth of the dictum that "it is unnecessary to put in a drainage tube if the amputation has been performed through healthy tissues, and the bleeding has been satisfactorily arrested." Most surgeons would prefer a twenty-four hours drainage tube to carry off the blood which inevitably oozes after the use of a tourniquet.

The anatomical data are on the whole precise and correct. The surface marking of the (superior) gluteal artery is not that with which most men are familiar, and the description of the anastomotica magna as a branch of the popliteal artery is frankly wrong.

Here and there the English is slipshod, as in the reference to the employment of electricity (p. 9); and the directions to the surgeon on p. 100 to stand "inside the limb," to be amputated, might be less ambiguously phrased.

These are faults of detail which detract but slightly from the value of the work as a résumé of the treatment of wounds in war.

MODERN CHEMISTRY AND ITS WONDERS. By Geoffrey Martin, D.Sc. Published by Sampson Low, Marston and Co., Ltd., London. Pp. xvi + 347.

The object of this book as stated in the preface is "to interest the cultured general reader in some of the really wonderful achievements of scientific chemistry." The author manages to achieve this ambition with considerable success, though it is occasionally difficult for him to avoid becoming technical.

The first seven and the last two chapters are perhaps the most interesting, but the whole book contains much useful information on subjects usually only to be obtained from highly technical text-books.

The fixation of atmospheric nitrogen by means of the electric arc is well explained in Chapter II.

Explosives are thoroughly described in Chapter III. Picric acid and T.N.T. are shown to be substances usually so docile that they may be burned without explosion. Some who have experienced the effects of shell fire may be surprised at this statement, but the author goes on to explain that mercury fulminate is capable as a detonator of instantly releasing the vast stores of energy in these compounds.

Radium is next dealt with, but one could have wished for an account of Madame Curie's patient analyses of uranium residues until the end was achieved. The diagrams in this chapter are very clear and the information afforded in the text is good.

Chapter V deals with the periodic law, due prominence being given to Newland's work in this connexion. Mendeléef's prophecies of new elements by means of this law are of absorbing interest.

Chapter VI will probably be found the least interesting of all to the general reader, but to the chemist no other chapter in the book quite equals it. It is a technical chapter, dealing with the relation of the radio-active elements to the periodic law, but well repays a little puzzling over.

Chapter VII is one of queries, for apparently the transmutation of elements is still highly debatable ground. Welsbach's work on incandescent mantles and metallic firestones is described and the author closes the work by letting us into the secret of artificially producing precious stones. The last two chapters are by no means the least interesting in the book.

Many of the smaller illustrations are somewhat poor in quality, but the full-page plates are good. It would be a decided advantage to omit the illustration on the cover and some few in the text. C. J. D. G.

INJURIES TO THE EYES, THROAT, NOSE AND EARS. By A. M. Ramsay, M.D.Glas., J. Dundas Grant, M.D., F.R.C.S.Eng., H. Lawson Whale, M.D., F.R.C.S.Eng., C. Ernest West, F.R.C.S.Eng. London: H. Frowde, Hodder and Stoughton, 1915. Pp. 160. Price 2s. 6d. net.

The special volume on Injuries of the Eyes, Nose, Throat and Ears has just appeared, and is a useful contribution to war medical literature.

A. Eyes.—Major A. Maitland Ramsay (R.A.M.C., T.F.), is responsible for the eye section, which covers one-third of the book. As might be expected from the reputation of the author, the opinions stated are clear, and the advice given is helpful and not too technical. Nothing need be said of the ordinary injuries, which differ only in degree from those of civil practice. Chapter VII, on Amblyopia due to Traumatic Neurosis, is interesting, and deals with a subject of which this war is furnishing very numerous illustrations. Major Ramsay's description of this condition (p. 63) exactly corresponds with the experience of the writer, who agrees that "these patients are in no sense of the word malingerers," and that "rest and, best of all, judicious encouragement help them at length to make a complete recovery." We hope that Chapter VIII, on "Ocular Signs accompanying Head Injuries," will some day develop into one of the most interesting results of the medical experience of the War. An important chapter, important to surgeons whose interest in eyes is secondary, is the fourth, on "Degenerative Changes after Perforating Wounds," and we agree with the author as to the risk accompanying the retention of a shrunken, though temporarily quiescent globe.

In any subsequent edition we should suggest to Major Ramsay the advisability of altering the wording of a sentence at the bottom of p. 12: "Not till after the patient has recovered consciousness is any complaint made of loss of sight." This is a true saying, no doubt, but hardly worthy of a place in the Primer.

Throat, Nose and Ears.—This War Primer is presumably intended for the guidance of officers in the R.A.M.C., who are not specialists, in helping them to deal with the earlier and simpler aspects of injuries to the nose, throat and ears.

The chapter on "Ears" will be found to fulfil this purpose faithfully, as it gives a concise, orderly and useful description of the subject, compressed into eight pages.

The chapters on the "Nose and Throat" are not so satisfactory as that on "Ears." Eleven pages are devoted to Anatomy, which seems to be superfluous in a book of this kind. Forty-three pages are devoted to notes of cases, which are instructive, if leaving much to be desired in their completeness as records. The unusual cases quoted in the text, from other observers, are only of interest to specialists.

In the Throat Section, on p. 114, wise restraint is urged against hunting unduly for projectiles and foreign bodies. The writers appear to have been unfortunate in their experience with X-rays, although one radiologist's method of localization is specially chosen for praise.

Under "Wounds of the Maxillary Sinus" on p. 85, the following statement occurs: "A bullet directed transversely may perforate one or both antra without leaving any trace as in cases 2, 8 and 13. More often, however, suppuration follows. One of us has found this inevitable

if in a bullet wound, the bullet lodges and remains in the sinus, and in all shrapnel wounds, whether the shrapnel remains in the sinus or not."

This conclusion as to the frequency of antral sepsis is not supported by the notes of cases, where at least fourteen are said to have had one or both antra perforated or damaged, and yet sepsis is mentioned in only four. In the experience of other observers who have had extensive opportunities of treating such injuries, absence of sepsis is the rule. The encouragement given in the following sentence to undue surgical interference is to be deprecated: "Those who might advisedly hesitate in dealing with any of the other accessory sinuses, may with all confidence attack the antrum of Highmore, knowing that the risks are comparatively small and the prospect of benefit enormous."

The treatment of a septic antrum, by drainage into the nose through an opening the size of a threepenny piece, as advised in Case 7 would be quite inadequate. Washing the sinus after meals, with fluid taken into the mouth and forced through an opening in the canine fossa across the antral cavity, is not to be recommended as the best type of modern surgery. Notwithstanding these and some other minor defects, the book as a whole will be found an instructive contribution to the war surgery of the regions dealt with.

Current Literature.

Pasteurizing Milk in Bottles and Bottling Hot Milk Pasteurized in Bulk.—By S. Henry Ayers, Bacteriologist, and W. T. Johnson, junr., Scientific Assistant, Dairy Division. (From *Bulletin* No. 240, United States Department of Agriculture, July 13, 1915.)

(1) The process of pasteurization in the bottle, using a temperature of 145° F. for thirty minutes, causes satisfactory bacterial reductions.

(2) Bottles should be steamed at least two minutes before being filled with milk in order to destroy heat-resistant types of organisms which might survive the pasteurizing temperature, and thereby increase the bacterial count.

(3) Care must be taken to record the temperature in the bottom of the bottle during the heating process. When milk at an initial temperature of 50° F. is heated in bottles without agitation in water at about 146° F., the temperature of the milk in the top of the bottle will reach 140° F. about nine minutes before that in the bottom. The temperature of the milk during the process of pasteurizing in the bottle should be recorded by placing a thermometer in a control bottle with the bulb of the thermometer about one-half inch from the bottom. The milk should be heated for thirty minutes at 145° F.

(4) When bottles are heated and cooled under water, care should be taken not to use bottles with chipped or otherwise imperfect tops, since the seal caps may allow leaks during the process of pasteurizing. It is advisable for the users of patented caps to assure themselves that the caps are watertight, since leaking caps may cause dangerous infections, particularly if the cooling water is polluted.

(5) The process of bottling pasteurized milk while hot in hot steamed bottles causes equally good bacterial reductions as does pasteurization in bottles. Even with the same length of exposure of thirty minutes and the same temperature of 145° F., the bacterial reductions are often much greater than those produced by pasteurization in bottles.

(6) In the process of bottling hot, bottle infection is eliminated, even when several cubic centimetres of old, sour milk are added to bottles before filling. The two-minute steaming period to which the bottles are subjected before filling with hot milk is sufficient to destroy the contamination, at least so far as bacteriological methods can detect.

(7) Laboratory experiments indicate that milk may be pasteurized, bottled hot, capped with ordinary cardboard caps, and cooled by a blast of cold air.

(8) It is probable that if milk is cooled from 145° to 50° F. within five hours no more bacterial increase will take place during the slow cooling than would take place if the milk were cooled immediately to 50° F. Whether or not this will be true under commerical conditions can be determined only by future experiments.

(9) So far as the laboratory experiments indicate, when milk is heated to 145° F. for thirty minutes, the bottling of the hot pasteurized milk followed by slow, gradual cooling has no more appreciable effect on the cream line or flavour of milk than the ordinary process of pasteurization. This is true of cooling periods of less than five hours' duration.

(10) Since milk contracts on cooling, a quart bottle filled with milk at 145° F. does not hold a full quart when the milk is cooled to 50° F. It is about 0·62 of an ounce short. Therefore slightly oversized bottles should be used.

(11) The advantages of the process from the commercial standpoint are: (1) That bottle infection can be eliminated; (2) that milk losses are saved, owing to evaporation over the cooler; and (3) that ordinary cardboard caps can be used. The principal disadvantage is that the air-cooling process requires several hours. This, however, would be a disadvantage only in the few plants where milk is delivered directly after pasteurization.

Study of the Bacteriology of the Posterior Nasopharynx in Scarlatina.—N. S. Ferry, M.D. (from the Research Laboratory of Parke, Davis and Co., Detroit, Mich.). At the request of Dr. E. C. Schultze, the study of the bacteriology of the posterior nasopharynx in scarlatina was undertaken by the writer in order to isolate and determine the rôle of a certain micrococcus found in this region and previously described by Schultze. This organism was seen in smears from four hundred and fifty-nine out of five hundred and fifty-five cultures taken from throats of patients suffering with typical symptoms of the disease.

The greatest number of positive findings have been obtained by swabbing the posterior pharyngeal wall and allowing the swab to stand in a test-tube of bouillon a few hours. The entire amount of bouillon was then plated in the usual manner. The organism was only isolated in the early stages of the disease and was not found in purulent discharges nor in the blood.

A streptococcus predominated on the plates, while the organism next

in order was that described by Schultze. For convenience in nomenclature this organism was called *Micrococcus* "*S*."

The *Micrococcus* "*S*" is a large coccus usually found in pairs and often in tetrads which grows luxuriantly in all culture media after the first few generations.

Morphology.—A large, clearly defined, biscuit-shaped diplococcus, sometimes appearing as tetrads, measuring about the size of the meningococcus or gonococcus, non-spore-bearing, non-motile, non-capsulated, stains deeply with all analine dyes and is positive to Gram.

Cultural Reactions.—Agar slant: Abundant smooth, greyish-white growth, glistening, opaque, becoming somewhat viscid within a few days. Agar deep: Abundant filiform growth. Bouillon: Slight growth, clear, with sediment. Gelatin stab: Gradual stratiform liquefaction. Litmus milk: No change. Indol: Negative. Litmus sugars: Glucose, maltose, and saccharose, acid reaction, galactose, levulose and lactose, no change. Non-pathogenic for animals. Monkeys were not affected by it in any way either by injection or when smeared on the throat.

The only way to obtain this coccus free from streptococci with which it is always associated is to plate out and then pick out colonies by means of a dissecting microscope. Individual colonies of *Micrococcus* "*S*" are invariably seen surrounded in extremely close proximity by minute colonies of streptococcus.

Micrococcus "*S*" must be differentiated from *Micrococcus catarrhalis*, *M. tetragenus* and *M. pharyngis siccus*, or *Diplococcus intracellularis meningitidis*.

Inasmuch as *Micrococcus* "*S*" is Gram positive and at the same time liquefies gelatine, it will be seen that these two reactions are all that are necessary to differentiate it from any of the organisms mentioned. Vaccines were prepared from this organism and some cases treated, but no curative action could be demonstrated. On the other hand, prophylactic injection of the vaccine was apparently followed by favourable results.

Some Phenomena involved in the Life-history of "Spirochæta Suis": Studies of Hog Cholera.—Walter E. King and Raymond H. Drake. (From the Research Laboratory, Detroit, Michigan.) *Preliminary Report of Filtration Experiments.*—Dujardin Beaumitz has pointed out that it is possible to obtain pure cultures of the organism of pleuropneumonia in cattle by passing heavily contaminated diluted lung exudate through Berkefeld filters, the large bacteria and spores are held back and the small specific organisms pass through and pure cultures can be obtained from the filtrate.

King and Drake were able to cultivate *S. suis* from the filtrate derived from an ulcer in the ear of a hog. They thus claim to have demonstrated the possibility of there being a filtrable stage (granule) in the life-history of *S. suis*.

INDEX TO VOLUME XXV.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

# JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

June, July, and August, 1915.

Q 180/34 — No. L.C. 74/3.

General Headquarters,
Mediterranean Expeditionary Force,
August 28, 1915.

To I. G. C.

The Commander-in-Chief desires me to express to you his satisfaction with the way in which the wounded and sick have been evacuated from the Peninsula during the operations since August 7. So far as he can judge the business of evacuation has passed off practically without a hitch, and in his opinion it reflects great credit on all concerned.

Will you please express to all concerned his appreciation of the way they have worked, and of the success of their endeavours.

(Signed), G. F. Ellison, Major-General, D.Q.M.G., M.E.F.

To D. D. M. S.

In forwarding above for your information and for communication to your staff, to Lieutenant-Colonel Garner, R.A.M.C., and to Medical Officers commanding hospitals, hospital ships, and temporary hospital ships, I desire to add my personal thanks for the devotion to duty, energy, and resourcefulness which enabled this satisfactory result to be attained.

(Signed), E. A. Altham, Lieutenant-General, I.G.C., M.E.F.

Mudros, August 31, 1915.

War Office,
August 25, 1915.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned officer to be a Companion of the Distinguished Service Order, in recognition of his gallantry and distinguished service in the Field:—

Captain Stanley Alwyn Smith, No. 3 Field Ambulance, Canadian Army Medical Corps.

For conspicuous gallantry and devotion to duty at Festubert on the night of May 20, 1915.

Captain Smith, with a party of eight men, went out voluntarily to remove the wounded from an orchard whilst under heavy fire, and eventually succeeded in bringing all into safety. Four of the eight men of the rescue party were wounded, and two of these have since died.

MILITARY CROSS. *July* 28, 1915.

The following notification appeared in the Supplement to the *London Gazette* of June 22, 1915:—

His Majesty the King has been graciously pleased to approve of the undermentioned honours and rewards for distinguished service in the Field, with effect from June 3, 1915, inclusive:—

ROYAL ARMY MEDICAL CORPS.

AWARDED THE MILITARY CROSS.

No. 8268 Serjeant-Major G. B. Walker.

DISTINGUISHED CONDUCT MEDALS.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned non-commissioned officers and men for acts of galantry and devotion to duty. (Second Supplement to the *London Gazette*, No. 29212, dated June 29, 1915.)

No. 12751 Serjeant T. B. Carter.

For most conspicuous and gallant conduct and devotion to duty at Houplines in tending the wounded under heavy fire, being often continuously on duty by day and night. This non-commissioned officer has previously displayed great gallantry in assisting the wounded under fire.

No. 7685 Private J. Cartwright.

For conspicuous devotion to duty since August, 1914, in tending the wounded frequently under fire. On February 25, 1915, he was reported for "most heroic" conduct under shell fire,

No. 587 Private A. W. Howitt.

For conspicuous gallantry and devotion to duty from December, 1914, to March, 1915, when in charge of an ambulance wagon. On more than one occasion he has volunteered for exceptionally dangerous duty, and during an action at Neuve Chapelle in October, 1914, was able to bring away two wagon loads after the troops had withdrawn from their positions.

No. 105 Serjeant F. Newman (now Staff Serjeant).

For conspicuous coolness and gallantry displayed during the periods November 16 to 20, 1914, and December 12, 1914, to March 31, 1915, when in charge of advanced dressing stations. In the presence of danger this non-commissioned officer has carried out his duties with great ability.

No. 11656 Serjeant H. J. V. Voisey.

For conspicuous gallantry throughout the campaign. He has displayed great coolness when collecting wounded at night and has shown excellent initiative on many occasions under fire. Serjeant Voisey performed very good work at the dressing station at Vailly in September, 1914. under very trying circumstances.

The Director General in recognition of the credit which these gallant actions reflect on the individuals concerned, and on the Corps, has directed that the Privates shall be promoted to the rank of Corporal as vacancies occur.

MENTIONED IN DESPATCHES.

The names of the following Warrant Officers, Non-commissioned Officers and men of the Royal Army Medical Corps, were mentioned in the despatch from the Field Marshal Commanding-in-Chief, British Forces in the Field, which was published in the *London Gazette*, No. 29200 of June 18, 1915.

Reg. No.	Rank and Name		Remarks
14050	Qmr.-Serjeant	Andrews, W.	
7438	Staff-Serjeant	Argent, W.	Acting Serjeant-Major.
7527	Private	Arnold, P. F.	
2217	,,	Avery, F...	
19106	,,	Bardwell, G. F.	
19812	Serjeant	Barron, F. P.	
10179	Private	Batchelor, P.	

Mentioned in Despatches—Continued.

No.	Rank and Name		Remarks
7174	Private	Benson, J. F.	
9115	,,	Blewitt, W. T.	
17964	Serjeant	Bowler, W.	Now Staff-Serjeant.
19665	,,	Boxall, H. G.	
7742	Private	Burdett, G.	
15027	Staff-Serjeant	Bush, W.	
18566	Corporal	Butler, H.	Now Serjeant.
7685	Private	Cartwright, J.	Now Corporal.
7247	,,	Chase, S. J.	
5190	Corporal	Clark, A.	
5018	,,	Cook, W. C.	
18222	Staff-Serjeant	Dady, A.	Now Qmr.-Serjeant.
20589	Private	Davis, W. J.	
19818	,,	Deakin, J. G.	
16115	Serjeant-Major	Dewberry, E. B.	
7695	Private	Emmerson, T.	
5145	,,	Evans, A.	
20732	,,	Floyd, H.	
14924	Staff-Serjeant	Forbes, J. G. A.	
8269	Serjeant-Major	Gibbs, G. A.	
10254	,,	Gillespie, A.	
14452	Corporal	Godfrey, F.	Now Serjeant.
20796	Private	Greenwood, H.	
284	Serjeant	Gregory, A. O.	
10831	,,	Gregory, H. W. G.	Acting Serjeant-Major.
16205	Qmr.-Serjeant	Gregson, T.	
2690	Private	Hamer, W. H.	
18443	Serjeant	Harris, G.	Now Staff-Serjeant.
9751	Private	Harrison, J.	
8633	,,	Hayne, E. W.	
18964	Serjeant	Herbert, G. W.	
1675	Private	Horrigan, P.	
18383	Serjeant	Hutchings, W.	,, ,,
17576	Staff-Serjeant	Ireson, J. R.	
17159	,,	Jones, C.	Acting Serjeant-Major.
2950	Private	Jones, J.	
10598	Qmr.-Serjeant	Knightley, P. G.	
17277	Private	Knowles, R. N.	
10221	Serjeant-Major	Larner, E.	
2484	Private	Last, W. A.	
1856	Serjeant	Leaney, A. F.	Now Staff-Serjeant.
12156	Private	Matchin, W.	
19863	Serjeant	Mattison, W. H.	
18330	,,	Mercer, J. N.	,, ,,
10073	Serjeant-Major	Merchant, W.	
3795	Corporal	Morrison, J.	
19509	Private	Mulley, H. F.	
18940	Qmr.-Serjeant	Musgrave, P. H.	
12506	Staff-Serjeant	O'Rourke, P. J.	
19296	Private	Owen, E. T. J.	
18453	Qmr.-Serjeant	Philbrook, F. A.	
19604	Serjeant	Pollock, R.	
19192	Staff-Serjeant	Poole, F.	
7536	Private	Pooley, A.	
113	Serjeant	Powell, J. D.	
1305	,,	Prince, H. M.	
15288	Qmr.-Serjeant	Prince, W. C.	
18158	Staff-Serjeant	Pursey, G. P.	Now Qmr.-Serjeant.
33169	Private	Reynolds, A. F.	

Mentioned in Despatches—**Continued.**

No.	Rank and Name		Remarks
10849	Qmr.-Serjeant	Richmond, C. E. T.	Now Serjeant-Major.
5600	Corporal	Roberts, R.	
14671	Staff-Serjeant	Robertson, W.	Now Qmr.-Serjeant.
754	Serjeant	Russell, H.	
11405	Staff-Serjeant	Scott, W.	
14290	Serjeant-Major	Scott-Badcock, W. H. ..	
1764	Serjeant	Selden, H. W.	
15483	Staff-Serjeant	Sharpe, E.	,, ,,
10711	Serjeant-Major	Sharpe, F. M.	
5648	Serjeant	Smith, E. F.	
11441	Serjeant-Major	Sprinks, H.	Now Quartermaster.
17568	,,	Steele, E.	
103	Staff-Serjeant	Steer, G. P.	
12779	,,	Stubbs, G.	Now Qmr.-Serjeant.
18772	Serjeant	Taylor, H. E.	
10200	Qmr.-Serjeant	Thomas, J. H.	Now Serjeant-Major.
19037	Serjeant	Thomas, W. B.	
6805	Private	Thorpe, B. P.	
17928	Staff-Serjeant	Toye, W. S.	Now Qmr.-Serjeant.
9467	,,	Tunn, C. J.	Acting Serjeant-Major.
8268	Serjeant-Major	Walker, G. B.	
14008	,,	Watt, D...	Now Quartermaster.
12302	Staff-Serjeant	Whyte, W.	
20852	Private	Wilkinson, H.	

His Imperial Majesty the Emperor of Russia has been graciously pleased to confer, with the approval of His Majesty the King, the undermentioned rewards for gallantry and distinguished service in the Field :—

THE ORDER OF ST. ANNE 4TH CLASS, INSCRIBED "FOR VALOUR IN WAR."

Lieutenant John Downie, M.B., Yorkshire Mounted Brigade Field Ambulance, Royal Army Medical Corps, Territorial Force.

CROSS OF THE ORDER OF ST. GEORGE 4TH CLASS.

No. 336 Serjeant Arthur William Brown, 81st Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 32713 Serjeant Tyler Morris Brown, No. 1, Canadian Field Ambulance.

No. 12751 Serjeant Thomas Baylis Carter, 19th Field Ambulance, Royal Army Medical Corps.

No. 35664 Serjeant Richard Rodney Davies, 14th Field Ambulance, Royal Army Medical Corps.

No. 11628 Serjeant Thomas Arthur Fullam, Royal Army Medical Corps.

No. 2484 Private William Arthur Last, 5th Cavalry Field Ambulance, Royal Army Medical Corps.

No. 972 Private Henry Charles Sell, 84th Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 7604 Private David Wolfe, No. 5 Field Ambulance, Royal Army Medical Corps.

MEDAL OF ST. GEORGE, 1ST CLASS.

No. 551 Serjeant Charles Ingram, 85th Field Ambulance, Royal Army Medical Corps, Territorial Force.

MEDAL OF ST. GEORGE 2ND CLASS.

No. 14077 Corporal Frank Malcolm Harris, Royal Army Medical Corps.

No. 18576 Staff-Serjeant William Lamkin, Royal Army Medical Corps.

MEDAL OF ST. GEORGE, 3RD CLASS.

No. 9939 Corporal Alexander Burns, Royal Army Medical Corps.

No. 7766 Private Walter Richard Fitch, Royal Army Medical Corps (attached 1st Battalion Hampshire Regiment).

Driver John Vicary Gibbs No. 1195, British Red Cross Society (attached No. 4 Ambulance Convoy).

No. 6805 Private Benjamin Patrick Thorpe, Royal Army Medical Corps.

No. 33191 Private Frank Turner, No. 2 Canadian Field Ambulance.

MEDAL OF ST. GEORGE, 4TH CLASS.

No. 7695 Private Thomas Emmerson, Royal Army Medical Corps (attached 2nd Battalion, King's Own Scottish Borderers).

No. 3311 Private William Hanson, No. 1 Field Ambulance, Royal Army Medical Corps.

No. 284 Private William Malone, St. John Ambulance Association (attached No. 4 Motor Ambulance Convoy).

No. 1249 Private Thomas Markes, 1st Cavalry Field Ambulance, Royal Army Medical Corps.

No. 3890 Sepoy (Ward Orderly) Sadardin, 59th Scinde Rifles (Frontier Force) (attached 112th Indian Field Ambulance).

No. 3177 Private Henry Stapleton, 3rd Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 182 Private Philip Mark Stephens, 86th Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 33470 Private Charles Barnard Tomkins, No. 3 Canadian Field Ambulance.

No. 20852 Private Harry Wilkinson, 18th Field Ambulance, Royal Army Medical Corps.

No. 2304 Private Albert E. Wright, 81st Field Ambulance, Royal Army Medical Corps, Territorial Force.

There are no restrictions as to the occasions on which these decorations may be worn. No individual applications for permission to wear them need, therefore, be submitted.

ARMY MEDICAL SERVICE.

Lieutenant-Colonel (temporary Colonel) Richard R. Sleman, M.D., Royal Army Medical Corps (Territorial Force); to be an Assistant Director of Medical Services, and to retain his temporary rank whilst so employed, dated August 5, 1915.

Colonel Robert J. Geddes, D.S.O., is retained on the Active List, and to be supernumerary, dated August 13, 1915.

Andrew Fullerton, F.R.C.S.I., to be temporary Colonel, dated September 1, 1915.

ROYAL ARMY MEDICAL CORPS.

Temporary Lieutenant (temporary Honorary Lieutenant-Colonel) Arthur S. Woodwark, M.D., to be temporary Lieutenant-Colonel, dated August 12, 1915.

The undermentioned to be temporary Majors:—

Dated June 12, 1915.—William Forsyth Jones to be temporary Major whilst employed with the Brook War Hospital.

Dated August 12, 1915.—John Harley Brooks, M.D., to be temporary Major whilst serving with the Mile End War Hospital.

Dated August 14, 1915.—Temporary Lieutenant Robert C. Brown, M.D., whilst employed in charge of the Springburn and Woodside Hospital, Glasgow.

Dated August 18, 1915.—Temporary Lieutenant Thomas W. Buckley, M.D., to be temporary Honorary Major whilst serving with the Princess Christian Hospital.

Dated August 21, 1915.—Temporary Captain George Stoker.

The undermentioned to be temporary Majors:—

Dated September 1, 1915.—Hamilton Clelland Marr, M.D.; Francis Martin Rouse Walshe, M.D.

The date of appointment of Hamilton Irving, M.B., F.R.C.S., as temporary Major, is September 1, 1915, and not as stated in the *Gazette* of July 28, 1915.

Ernest Frederick Eliot, F.R.C.S.Edin., to be temporary Major, dated April 11, 1915. (Substituted for the notification which appeared in the *Gazette* of June 23, 1915.)

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated July 15, 1915.—Henry William Martindale Kendall, late Captain, Army Medical Staff.

Dated August 5, 1915.—Ernest E. S. J. Galbraith; William T. Hessel, M.B.; Arthur T. Todd, M.B.; Frederick W. Robinson, M.D., F.R.C.S.; Frank Whitby, M.B.

Dated August 6, 1915.—Richard B. Lilly.

Dated August 7, 1915.—Harold A. Douglas, M.B.; Malcolm Donaldson, M.B., F.R.C.S.; Arthur J. Eagleton, M.B.: William Kelsey-Fry; Horace W. Hay; Charles S. P. Hamilton; William M. Howells, M.B.; George D. Jameson; William Allan, M.B.; Hamish M. Anderson, M.B.; Kenneth B. Aikman; Henry W. Batchelor; St. John D. Buxton; Howard A. Bell; Sidney A. Boyd, F.R.C.S.; John A. Cowan, M.B.; Louis Lazarus; Harold Y. Mansfield, M.B.; Reginald K. MacGregor; Alexander F. Potter; Duncan W. Pailthorpe; Henry D. Robb, M.B. William H. D. Smith, M.B.; Ernest Scott, M.B.; John Fraser Taylor, M.B.; Herbert A. Watermeyer; Martyn H. Watney, M.B.; Charles S. E. Wright, M.B.; Owen L. V. de Wesselow, M.B.; Arthur J. Waugh; Ivan S. Wilson, M.D., F.R.C.S.

Dated August 8, 1915.—William H. Lister; Charles W. B. Littlejohn, M.B.; Rupert S. Scott, Vernon C. W. Vickers; Henry B. Owens; Percy P. Butler.

Dated August 9, 1915.—Francis Henderson, M.B; William E. Hallinan; Eric L. MacKenzie, M.B.; Hyacinth B. Morgan, M.B.; Herbert O'Callaghan, M.B.; Robert K. Sutherland, M.B.; William G. Waugh, M.D.; Lionel D. Woods; Thomas L. Fraser, M.B.; Stanley Arnott, M.B.; Edward Billing.

Dated August 10, 1915.—Frederick C. Davies, M.B.; Wilberforce V. Eaves, M.D.; Walter Groome, M.B.: Arthur S. Glynn, M.B.; John Greene: William G. Goudie, M.B.; John B. Haycraft, M.D.; William O. Halpin, M.D.; George M. W. Hodges, M.B.; Cecil B. Hogg, M.B.; Claude C. Harrison, M.B.; Ronald Hodson, M.B.; John L. Jackson, M.B.; Geoffrey T. Loughborough; Alan Mann, M.B.; Colin Mackenzie, F.R.C.S.; Hugh W. Moir, M.B.; Findlay Murchie, M.B.; Hugh J. Orr-Ewing, M.B.; Francis W. O'Connor; James E. H. Roberts, M.B., F.R.C.S.; Wilfred A. Russell, M.B.; Edmund L. Reid, M.B., F.R.C.S.Edin.; William J. Stewart, M.B.; Maitland Scott; Cyril Sherris, M.B.; Ronald Silcock; Reginald S. S. Statham, M.D.; Lionel H. Y. Stephen; James S. Stewart, M.B.; Thomas V. Somerville; Gerard A. Smythe, M.B.; Robert S. Snowie, M.B.: Vincent Townrow, M.B., F.R.C.S,; Cyril E. Thwaites; Hugh D. Willis, M.B.; Frederick E. S. Willis: Eric Wordley, M.B.; Charles H. S. Webb, M.B., F.R.C.S.; Donald McD. Wilson, M.B.; Philip R. Woodhouse, M.B,: Charles Weller, F.R.C.S.: Humphrey B. Wilson, M.D.; Basil W. Armstrong; William R. Addis, M.B.; Norman Briggs; Lancelot G. Bourdillon; Gavin S. Brown, M.B.; John B. Burgess, M.D.; Arthur E. Bullock; Monamy A. C. Buckell, M.B.; Bertram F. Bartlett; Charles N. Binney, M.B.: Cryil J. W. Clayton; George M. Campbell, M.B.; David H. Clarke, M.B.

Dated August 11, 1915.—Walter S. Danks, M.D.: William F. Evans, M.D.; Wilfred F. Hawkins, M.B.; Leonard L. Hadley, M.B.; William H. Johnston; Herbert H. P. Morton; Henry Moore; John Morris; Victor E. Negus; Duncan J. McRae, M.B.; Norman P. Pritchard; William A. Ryan, M.B.; Harold B. G. Russell; Nicol McN. Rankin, M.B.; Robert L. Roe, M.B.; Adrian D. Stokes, M.D., F.R.C.S.I.; Ralph L. Scott, M.B., F.R.C.S.Edin.; Francis R. Thornton, M.B.; Henry E. Wiltshire; Harold E. McM. Wall; John B. Young, M.B.; Ralph D. O'Leary, M.B.; Edward W. Carrington, M.B.; Alexander B. Cheves, M.B.

Dated August 12, 1915.—Cedric L. Dold, M.B.; Henry de C. Dillon, M.B.; James H. Dible, M.B.; Charles H. Evans, F.R.C.S.Edin; Joseph H. Elliott, M.D.; John McI. Falkiner, F.R.C.S.I.; James R. C. Greenlees, D.S.O., M.D.; Joseph G. Greenfield, M.B.; Thomas H. Holroyd, M.B.; George W. Kendall, M.D.; Thomas M. Low, M.B.; George A. Lilly; Clement R. Macleod, M.B.; Stuart A. O. Mackenzie, F.R.C.S.Edin.; Henry F. Mullan; Sidney H. Nathan, M.D.; Montgomery P. Paton, M.B.; Charles M. Row; James H. Ritchie, M.B.; William L. Scott, M.B.; Herbert W. Smith, M.B.; Frederick J. Thorne, M.B.; Russell E. Walker, M.B.; Frederick J. Whitelaw, M.B.; Edward A. Aldridge; Henry J. Burke; Cyril A. Bernard.

Dated August 13, 1915.—Kenneth B. Dickson; Charles H. Denham, M.B.; Alexander R. Esler; William B. Gordon; Oliver K. Hartridge, M.B.; Frederick T. Hill; James E. T. Jones; James D. Jones; Trevor A. Lawder, M.B.; Thomas Martin, M.B.; Hugh J. More, M.D., F.R.C.S.; Samuel W. McLellan, M.D.; Frederick L. Napier, M.B.; George Rickman; Charles M. Rout, M.B.; David H. Russell, M.D., F.R.C.S.Edin.; Granville D. Robertson; Robert B. Rutherford, M.B.; John Sainsbury, M.B.; George W. Smith, M.B.; Arthur F. S. Sladden, M.D.; Humphrey M. Hart-Smith, M.B.; Herbert Walker; Spencer L. Walker, M.B.

Dated August 14, 1915.—William Duguid, M.B.; George Elkington, M.B.; George

D. Ferguson, M.B.; Gilbert L. K. Finlay, M.B.; Geoffrey P. Humphery, M.B.; Robert H. C. Lyons, M.B.; George R. D. McGeagh; Edward J. Nangle; Edward O'Connor, M.B.; Arthur S. Plant; Hubert A. Pallant; John W. Pell; John F. G. Richards, M.B.; Carlyle Aldis, M.D.; Robert M. Alcorn; Cecil Bluett; Aleck W. Bourne, M.B., F.R.C.S.; Gurth S. Blandy, M.D.; John D. Carroll, M.B.

Dated August 15, 1915.—Robert V. Dolbey, F.R.C.S.; Richard E. Gibson, M.B.; Cameron R. Gibson, M.B.; Charles E. Hibbard; John H. Hood, M.B.; Frederick M. S. Hulke; Thomson Henderson, M.B.; Henry J. R. Jones; Basil T. Lang, F.R.C.S.; Robert E. Lee, M.B.; John B. Lowe, M.B.; George C. M. M'Gonigle, M.D.; Leslie Meakin; John B. Matthews; Philip W. Maclagan, M.B.; Henry F. Marris, M.B.; John A. MacLeod, M.B.; William B. Purchase; Andrew E. S. Pringle-Pattison, M.B.; Henry E. Peake, M.B.; Joseph A. Quin, M.B.; Alexander A. Rees, M.D.; Edwin C. Rayner; Harold Sheldon, M.B.; Hugh L. Sells, M.B.; Lawrence L. Satow; Richard W. Smith, M.B.; James L. Stewart, M.B.; Victor F. Soothill, M.B.; Douglas W. Smith, M.B., F.R.C.S; Arthur Tilbury; Oscar R. L. Wilson, M.B.; Alfred S. Wakeley; Frederick B. Winfield; Robert J. B. Madden, M.B.; Reginald H. Jones, M.B.; William D. Arthur; James N. Armstrong, M.B.; George N. Braham, F.R.C.S.Edin.; Hamish D. F. Brand, M.B.; Arthur Joseph Blake.

Dated August 16, 1915.—Philip Ferguson, M.B., F.R.C.S.; Edward G. Foley; Carleton Y. Ford, M.D.; James F. Fairley, M.B., F.R.C.S.; Ernest H. Griffin, M.D.; Thomas Hardy, M.B.; Theodore H. Just, M.B.; Geoffrey L. Keynes; George J. W. Keigwin; Joseph P. Little; Edmund H. Moore, D.S.O., M.B.; Adolph R. N. MacGillycuddy; John H. Meers; Kenneth P. Mackenzie, M.B.; Edward Thomas C. Milligan, M.D.; Sydney F. McDonald, M.D.; Ernest S. Miller, M.D.; Hector Mortimer, M.B.; Robert M. Miller; Charles J. O'Reilly, M.D.; Maurice N. Perrin; Thomas E. Parrer, M.B.; Charles P. Porter; William E. Reid, M.B.; Horatio F. N. Scott, M.D.; William V. T. Styles; Alexander W. Uloth; Bernard H. Well, M.D.; Thomas S. Allen; George G. Anderson, M.B.; Henry Cordner, M.B.; Francis H. Cleveland; William L. Cassells, M.B.; Frank D. Cairns, M.B.

Dated August 17, 1915.—John M. Gillespie, M.B.; George W. L. Kirk, M.B.; David C. Monro, M.B.; Herbert F. W. Adams, M.B.; Frederick C. Atkinson-Fleming, M.B.; Alexander Baldie, M.B.

Dated August 18, 1915.—William Foot, M.B.; Alexander T. I. MacDonald, M.D.; Frederick C. K. Austin, M.B.; Allan L. Christie, M.B.

Dated August 19, 1915.—John C. Hallinan; Ivan C. Maclean, M.D.

Dated August 20, 1915.—Arthur W. Dennis, M.B.; Byron L. Hutchence; Arthur D. Haydon; Arthur G. Maitland-Jones; John W. Linnell, M.D.; Robert R. Archibald, M.B.; Ian M. Brown.

Dated August 22, 1915.—Walter Dawson, M.B.; Cosmo W. Fowler, M.B.; Rudolf W. Galloway, M.B.; Harry L. S. Griffiths; Robert H. Hodges; Ronald N. Hunter; Charles H. Hart, M.B.; William Henderson, M.B.; Francis H. Moxon, M.B.; John M. McLaggan, M.B.; Francis L. Nash-Wortham, F.R.C.S.Edin.; John Proctor, M.B.; William D. Reid, M.B.; Andrew Topping, M.B.; Edward H. Udall; Gerald N. B. Sebastian; Leslie Adamson, M.D.; Galvin A. E. Argo, M.B.; Edward W. Archer, M.B.; Robert H. Alexander, M.B.; Mark B. Baines, M.D.; John S. Buchanan, M.B.; David D. Craig, M.B.; Spencer S. Crosse.

Dated August 28, 1915.—John Lewis Maitland Govan.

Dated September 8, 1915.—Temporary Lieutenant Francis Charlesworth, M.B.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated August 13, 1915.—Norman F. Hallows, M.B.; George H. Varley, M.B.; Rex Stansfeld; Alan D. Anderson; Aubrey D. Vernon-Taylor; Algernon C. S. Smith; David L. Lewis; William A. Stewart; Herbert W. Cooke.

Dated August 14, 1915.—Horace F. W. Warden; John Hewat, M.D

Dated August 15, 1915.—Dumaresq Le Bas; David Morrow; Henry D. Gasteen; Raymond B. Taylor, M.B.; James J. Woodburn, M.B.; Andrew D. Carberry, F.R.C.S.I.; Hugh P. Costobadie, F.R.C.S.Edin.; Sidney T. Davies; Harold B. Whitehouse, F.R.C.S.; Edward E. Steele, M.D.; Arthur N. Hodges, M.B.

Dated August 16, 1915.—Richard D. Passey, M.B.; Henry L. Martyn, M.B., F.R.C.S., Harold E. Battle.

Dated August 17, 1915.—James A. Raeburn, M.D.: Alister F. Cowan, M.B.; Arthur Turnbull, M.B.

Dated August 22, 1915.—Gideon R. E. Colquhoun; Durie A. Chamberlain; Thomas Gilchrist, M.B.; Douglas McAlpine, M.B.; Issachar R. Smith, M.B.; Thomas S. Stafford; Michael J. Cronin, M.B.; Cresswell L. Pattison, M.B.; John M. Wilson.

The undermentioned to be temporary Lieutenants:—

Dated July 3, 1915.—Charles Richard Whittaker, F.R.C.S.Edin.

Dated July 10, 1915.—James Mitchell Whyte, M.B.; Alexander Frew, M.D.; Francis C. Drew, M.B.; John Michael Verster, M.B.; Ernest France Watson, M.B.

Dated July 25, 1915.—Richard William Ely Roe.

Dated July 16, 1915.—Lieutenant Norman Burke Taylor, M.B., F.R.C.S.Edin., Canadian Army Medical Corps.

Dated July 24, 1915.—James Mary Joseph Allen Levines; Ernest Louis Marsh, M.B.

Dated July 25, 1915.—Charles Gerald Harmer, M.D.

Dated July 28, 1915.—Frederick Arthur Martin Flegg; Frederick Wyndham Chamberlain; Melville Krolik, M.D.; Owen Douglas Price, M.B.; John Pritchard; Thomas Lindsay Clark, M.B.; William Noel Child; Donald Ewart Morley, M.B.; John Rodger, M.B.; Charles Augustus Eamonson Ring, F.R.C.S.Edin.; Sydney Victor Shrimpton; Thomas Morton Johnston Stewart, M.B.; William Graham Scott; Frederick Naylor Stewart, M.D.; Harold Hope Scott; William Turner, M.B.; Maurice Excll Willcock, M.P.; John Hemphill Rutter, M.B.

Dated July 29, 1915.—George William Elder, M.B.; John Pearce Whetter, M.B.; Murdo McKenzie McRae, M.B.; Austin Harvey Huycke, M.D.

Dated July 30, 1915.—Walter Weir Galbraith, M.B.; Frederick Alexander Anderson, M.D.; Reginald Anson Mansell, M.B.; James MacCormac Caldwell Johnston, M.B.; Robert Stewart Ross, M.B.; Gerald Struan Marshall.

Dated July 31, 1915.—John James Mackintosh, M.B.; Diederick Johannes Dauth, M.B.; James Frederick Matheson, M.B.; George Elphinstone Keith, M.B.; Ralph Cox, M.B.; Edward Melville Bruce Payne; John Carr Robertson, M.B.; Charles Lyle Sproule; Charles Kidd, M.B.; Joseph Dunlop, M.B.

Dated August 2, 1915.—Ralph Boutwood.

Dated August 3, 1915.—Arthur William Johnson.

Dated August 4, 1915.—Everard William Lewen Sharp to be temporary Honorary Lieutenant.

Dated August 8, 1915.—McWilliams Henry, F.R.C.S.Edin.

Dated August 9, 1915,—George Stewart Clark, M.D.; William Allan Young, M.B.; Francis George Cross, F.R.C.S.; John Reid, M.D.; Charles Dickson, M.D.; Harry Stokes; William John Gibson; John Walker; Edward Mountjoy Pearse; Robert Wilson, M.B.; Hamilton Brown Lord Henderson, M.B.; George Charles Gaynor, M.B.; Josiah Rowland Benjamin Dobson, M.B.; Thomas Herrick Sarsfield; Douglas James Glen, M.B.; George Joughin, M.B.

Dated August 10, 1915.—Lionel John Lock; Philip Rutherford Boswell; Alexander Urquhart Webster, M.B.; Charles Renfric Chichester, M.B.; Frederick Reginald Sturridge; Joseph Paterson Lusk, M.B.; Harold Reginald Wessen Husbands; Blacker Castles Powell, M.B.; William Rickard Lloyd Waters, M.B.; Herdman Porter, M.B.; Frank Percival Montgomery, M.B.; Robert Boyd Robson, M.B.; Lorimor Gifford Nash.

Dated August 11, 1915.—Robert Hugh Russell McKean; John Inman Langley; Noel Archibald Scott; John Vincent Bates.

Dated August 12, 1915.—Bertram Chiene Letts, M.B.; Joseph Vincent Duffy; James Patrick O'Hea, M.B., F.R.C.S.; Arthur Walton Rowe, M.B.; James Alexander Cowie, M.D. F.R.C.S.Edin.; Frederick Vaudry Cant; Russell Walbaucke Hodgson-Jones; James Hepburn, M.B.; Harold Pringle, M.D., F.R.C.S.I.; Charles William Sanderson Davies-Jones, M.B.; Robert Arthur Welsford Proctor; William John Hogg.

Dated August 13, 1915.—Edward Leonard Taylor; James L. Wilson, M.B.; Charles James Stanley, M.B.

Dated August 14, 1915.—Harry Seymour Laird; Eric Biddle; Vernon Edmund Lloyd; Robert Ferguson Copland, M.B.; Carmel Samut, M.D.; Joseph Morgan Richey, M.B.; Stanley Ernest York Elliott; Arthur Willatt; John Tolmie MacKenzie; William Waddell, M.D.; James Lawson Russell, M.B.; Arthur George Troup, M.D.; Robert Marshall Hume, M.B.; Charles Patrick Kelly, M.B.; Kenneth Noel Purkis; William Irving, M.D.; Edmund Benjamin Jones, F.R.C.S.; Joseph Walker, M.D.; Patrick George Milne, M.B.; William Campbell, M.B.

Dated August 15, 1915.—Arthur George Mossop.

Dated August 16, 1915.—John Colley Pounden Beatty, M.B.; Thomas Jackson Gilmore, M.B.; Arthur Frederick Cole; Frederick Otto Stohr, M.D.; Maurice Smith Bryce, M.B.; Lionel Eugene Sutcliffe, M.B.; Dennis Cregan McCabe-Dallas; Morris John Theodore Wallis; William Thomas Ingestre Abell.

Dated August 17, 1915.—Herbert Wales, M.B.; William Forsyth, M.B.

Dated August 18, 1915.—Fritz Salo Eschwege; John Beattie McFarland; Charles Reginald Hoskyn, M.D.; William George Theaker Story, M.B.; Richard Athlestane Parker Hill, M.D.; Robert Henry Wilson, M.B.; Terence Patrick McQuaid, M.B.; John Campbell, M.B.; Colin Campbell Blair Gilmour, M.B.; Andrew Gibson, M.B., F.R.C.S.Edin.; George Francis Palmer Heathcote, M.B.; James Alphonsus Conway, M.D.; William Cullen, M.D.; David Macquorn-Rankine Crighton, M.B.; Thomas Scott Brodie, M.B.; Patrick Joseph Lane, M.B.; Ewan Gordon Cameron; Robert Fenwick Linton, M.B.; Charles Carrick Brewis.

Temporary Lieutenant Harold McAllum, M.B., relinquishes his commission, dated October 17, 1914.

Lieutenant Ian Macdonald, M.D., F.R.C.S.Edin., relinquishes his temporary commission on account of ill-health, dated July 29, 1915. (Substituted for the notification which appeared in the *Gazette* of May 22, 1915.)

The date on which the undermentioned temporary Lieutenants relinquish their commissions is August 7, 1915, and not as stated in the *Gazette* of August 18, 1915:—

Maitland Radford, M.B.; Gilbert C. Chubb, M.D., F.R.C.S.; Robert G. Brown; Alma P. Ford; Frederick G. Chandler, M.B.; George C. Metcalfe; Arthur G. H. Lovell, M.D., F.R.C.S.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated August 9, 1915.—Henry Robinson, M.D.; Arthur E. Brown; Bernard V. Dunne, M.B.

Dated August 10, 1915.—John S. Avery, M.B.; John Dotto; Montague S. Woolf; John Whigham, M.B.; Philip W. James, M.D.; Cornelius Molan; Robert J. Harley-Mason.

Dated August 11, 1915.—Charles S. Atkin; Cecil K. Attlee; Edward N. Graham, F.R.C.S.; Neville C. Wallis; John A. West.

Dated August 12, 1915.—Thomas A. Jones, M.D.; Andrew B. Lindsay, M.B.; Charles W. Forsyth, M.B.; William A. Wilson-Smith, M.D.; Henry G. Greaves, M.B.

The notification regarding Ralph Boutwood and Arthur William Johnson, which appeared in the *Gazette* of August 19, 1915, is cancelled.

Temporary Lieutenant Frederick G. Thomson, M.B., relinquishes his commission on account of ill-health, dated September 1, 1915.

Temporary Lieutenant William R. A. Coates relinquishes his commission on account of ill-health, dated September 4, 1915.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated August 16, 1915.—Alfred Jackson.

Dated August 20, 1915.—John Suffield Whestone.

Dated August 22, 1915.—John Goodwin.

Dated August 25, 1915.—Francis George Payne.

Dated August 28, 1915.—John Thomas Cooke; Herbert Hargreaves Donnelly; William Frederick Grocott; William John Cyril Merryman; Edwin Turner Grundy.

Dated August 30, 1915.—George Edward Barney; John Watson.

Dated August 31, 1915.—Archibald James Andrews.

Dated May 5, 1915.—Quartermaster and Honorary Captain Edwin Houghton, retired pay, Royal Army Medical Corps, to be honorary Major.

WARRANT OFFICERS, NON-COMMISSIONED OFFICERS, AND MEN.

The following promotions to complete War Establishment will take effect from the dates specified:—

To be Quartermaster-Serjeants.

No.	Rank and Name		Date	Remarks
10511	Staff-Serjt.	Morgan, F.	1.7.15	
13035	,,	Chandler, G. V. ..	7.7.15	
17358	,,	Ennor, C.	,,	
12709	,,	Ford, H. J.	15.7.15	
17091	,,	Moore, J.	19.7.15	
19320	,,	Ritchie, H. A. ..	24.7.15	

To be Staff Serjeants.

No.	Rank and Name		Date	Remarks
12547	Serjeant	Triggs, A.	1.7.15	
19032	,,	Cooke, J.	,,	
19282	,,	Golden, H.	7.7.15	
1843	,,	Mack, C. A.	,,	
1905	,,	Eves, J. G.	,,	
19747	,,	Hyde, C. H.	,,	
1620	,,	Pegg, A. E.	15.7.15	
18898	,,	Green, G. H.	,,	
19086	,,	Wain, A.	19.7.15	
19193	,,	Stebbings, W. M. ..	,,	
18604	,,	Tindall, W.	24.7.15	
18982	,,	Newman, A.	,,	

To be Serjeants.

5108	Corporal	Westwood, C.	20.1.15	As being in possession of A.F.C. 344. With seniority next below No. 5023 Serjeant R. Grist.
19128	,,	Burr, W. G.	9.5.15	As being in possession of A.F.C. 344. With seniority next below No. 12650 Serjeant E. Wyke.
11894	,,	Snow, R.	,,	
19698	,,	Wass, M.	13.5.15	As being in possession of A.F.C. 344. With seniority next below No. 15289 Serjeant H. R. M. Rodman.
1556	,,	Calvert, N. B. ..	1.6.15	As being in possession of A.F.C. 344. With seniority next below No. 12344 Serjeant F. H. Lucas.
11414	Lance-Serjt.	Wade, H. J.	28.6.15	—
1430	Corporal	Perkins, W. T. ..	29.6.15	Special as clerk.
1490	,,	Lansdowne, E. W. ..	1.7.15	As being in possession of A.F.C. 344.
4962	,,	Matheson, J.	,,	Special as clerk.
17215	,,	Lilley, W. A.	7.7.15	—
18714	,,	Knight, J.	,,	—
16979	,,	Egan, R. V. V. ..	,,	—
17894	,,	Syrett, G. R.	,,	—
19135	,,	Quelch, W. H. ..	15.7.15	As being in possession of A.F.C. 344.
18243	,,	Vincent, W.	,,	—
18506	,,	Cray, R. W.	19.7.15	—
18524	,,	Smitherman, T. H. ..	,,	—
16155	,,	Clarke, G.	24.7.15	—
18689	,,	Appleton, C.	,,	—

To be Corporals.

No.	Rank and Name		Date	Remarks
2281	Private	Edington, T.	28.6.15	In accordance with Corps Order No. 58 of this date.
5843	,,	Fraser, J.	,,	
7744	,,	Cronin, J. L.	,,	
5844	,,	Dilks, M.	,,	
4635	,,	Pawley, G. E. ..	,,	
5106	,,	Clarke, A. E.	,,	
5263	,,	Romney, T. A. ..	,,	
5371	,,	Dunne, D.	,,	
5386	,,	Gray, F. A.	,,	
5482	,,	Laird, A. G.	,,	
6439	,,	L'Arminie, G. ..	,,	
6479	,,	Chifney, T. G. ..	,,	
20271	,,	Morris, J.	,,	
20467	,,	Drew, A. J.	,,	
20601	,,	Naude, A. E.	,,	
7685	,,	Cartwright, J. ..	29.6.15	
587	,,	Howitt, A. W. ..	30.6.15	
5641	,,	Brown, T.	1.7.15	
5630	,,	Ely, T. O.	,,	
12346	,,	McReavie, D... ..	4.7.15	
5808	,,	Maxwell, M. M. D. ..	7.7.15	
5884	,,	Jay, E. B.	,,	
5905	,,	Elliott, W.	,,	
5952	,,	Rendell, C. E. ..	,,	
15724	,,	Bush, C. H.	15.7.15	
6017	,,	Moody, H.	,,	
12318	,,	Dart, F. C.	19.7.15	
2904	,,	Mossop, G.	,,	
2652	,,	White, F. W... ..	24.7.15	
2843	,,	Brown, A.	,,	
3886	,,	Palmer, F. E. ..	,,	

These promotions are subject to the conditions laid down in paragraph 35 Standing Orders, Royal Army Medical Corps, 1914.

AWARD OF ARMY FORM "C. 344."

The undermentioned have been awarded Army Form C. 344 on completion of three years' training in accordance with Paragraph 330 Standing Orders on the dates specified :—

No.	Rank and Name		Date	Remarks
5108	Corporal	Westwood, C.	13.1.15	
1569	Serjeant	Farmer, G. L. ..	28.6.15	
12819	Staff-Serjt.	Riches, W. H. ..	21.7.15	

NURSING SECTION.

The following appointments to the Nursing Section of the Corps will take effect from the dates specified :—

No.	Rank and Name		Date	No.	Rank and Name		Date
9596	Private	Cooper, F. ..	14.6.15	5874	Private	Cripps, A. W.	28.6.15
4499	,,	Browning, S...	20.6.15	2718	,,	Gilburd, E. ..	,,
5985	,,	Burke, P. ..	,,	19165	,,	Faith, A. E. ..	,,
4486	,,	Campion, B. R.	,,	2928	,,	McKinley, T.	,,
7541	,,	Midgley, C. ..	,,	868	,,	Cobie, H. T...	3.7.15
1570	,,	Gorton, C. ..	,,	18499	,,	Haveron, J. ..	,,
2458	,,	Delaney, C. ..	,,	1257	,,	Fitzpatrick,	,,
4464	,,	Sewell, F. J...	,,			D. C.	
392	,,	Sparks, J. ..	21.6.15	2351	,,	Brown, M. ..	,,
10718	,,	Stone, R. F...	,,	5815	,,	Hearnden, W.	,,
10642	,,	Allan, H. ..	,,	5787	,,	Griffiths, L. J.	3.7.15
8589	,,	Arnold, C. ..	,,	7797	,,	Firth, G. W...	,,
8945	,,	Bass, A. ..	,,	10627	,,	Porter, H. ..	5.7.15
8942	,,	Green, G. H...	,,	400	,,	Gallagher, P.	,,
10321	,,	Kent, C. W...	,,	7529	,,	Capel, J. W...	6.7.15
8898	,,	Patterson, D.	,,	6971	,,	Collier, G. E.	,,
10226	,,	Tozer, W. ..	,,	12641	,,	Hurst, A. H...	,,
8940	,,	Vallender, J. J.	,,	7799	,,	McCord, S. ..	,,
3397	,,	Neary, M. ..	22.6.15	5809	,,	Pitt, P. ..	,,
4476	,,	Hewitt, G. ..	,,	20314	,,	Sheen, E. ..	,,
10169	,,	Morgan, H. ..	23.6.15	4723	,,	Samson, W. ..	,,
10533	,,	Sutherland, G.	,,	6399	,,	Taylor, B. L...	,,
2761	,,	Taylor, R. J...	,,	502	,,	Thornhill, R..	,,
1188	,,	Doyle, M. ..	24.6.15	3508	,,	Armstrong, A.	,,
19116	,,	Dodgson, T. ..	,,	16374	,,	Barney, E. H.	,,
		(re-appointed)		20148	,,	Bell, E. J. S...	,,
5302	,,	Hayter, J. W.	,,	6537	,,	Bedford, F. A.	,,
3109	,,	Rice, S. ..	,,	20407	,,	Bryan, T. W.	,,
6114	,,	Love, G. G. ..	,,	20462	,,	Chadwick, A...	,,
3491	,,	Marston, W...	,,	17715	,,	Claydon, G. ..	,,
2553	,,	McCullagh, H.	,,	209	,,	Croxford, C. ..	,,
2555	,,	Molloy, T. ..	,,			(re-appointed)	
28	,,	Bracken, J. ..	,,	17782	,,	Curry, H. ..	,,
500	,,	Majury, J. ..	,,	20610	,,	Elliott, W. A.	,,
1702	,,	Ranson, A. E.	,,	4883	,,	Long, J. W. ..	,,
3232	,,	Smyth, J. ..	,,	6129	,,	McDermott, J.	,,
10679	,,	Upfold, L. A.	,,	7864	,,	Merrill, C. C.	,,
480	,,	Bell, J. ..	25.6.15	2845	,,	Moore, F. ..	,,
3542	,,	Brammeld, H.	,,	5519	,,	Nicolle, W. ..	,,
3541	,,	Cameron, J...	,,	7754	,,	Reast, A. W.	,,
3579	,,	Deans, J. ..	,,	10800	,,	Simpson, H...	,,
3522	,,	Doyle, P. ..	,,	4633	,,	Sowden, C. ..	,,
4121	,,	Doherty, G. ..	,,	136	,,	Wood, C. H...	,,
3521	,,	Kennedy, M...	,,	7841	,,	Hendry, J. ..	11.7.15
2570	,,	Kerwin, P. ..	,,	861	,,	Matheson, A..	12.7.15
71	,,	Lane, C. H. ..	,,	7433	,,	Berryman, H.T.	14.7.15
6139	,,	Mahoney, J...	,,	10051	,,	Cooke, F. ..	,,
5381	,,	McColl, C. S...	,,	10309	,,	Connah, J. ..	,,
1928	,,	Orr, A. ..	,,	10345	,,	Eastwood, S...	,,
3578	,,	Reilly, E. ..	,,	10514	,,	Gibson, H. ..	,,
309	,,	Turner, A. J.	,,	402	,,	Sebeck, A. ..	,,
7778	,,	Walton, T. ..	2.7.15	7441	,,	Cousins, A. E.	,,
10459	,,	Murphy, J. ..	,,	10339	,,	Caton, J. ..	,,
2971	,,	Jones, H. W...	,,	10397	,,	Dawes, T. ..	,,
6105	,,	Norris, S. ..	,,	10348	,,	Gibbons, C. J.	,,
1756	,,	Connolly, F. P.	,,	10859	,,	Sibley, W. J.	,,
2025	,,	Dawson, S. ..	,,	6262	,,	Lovegrove,	15.7.15
7545	,,	Heath, W. N.	,,			E. A. J.	
3792	,,	Bravery, J. W.	,,	6795	,,	Norrie, C. ..	,,
4325	,,	Turtle, J. ..	28.6.15	1320	,,	Johnstone, W.	,,
7228	,,	Whelan, J. ..	,,	6244	,,	Dewey, R. J.	20.7.15

ADVANCEMENT OF PRIVATES (CORPS PAY).

The following advancements in rate of Corps Pay will take effect from July 28, 1915:—

To be advanced to the Third Rate (at 8d.).

As Orderlies.

No.	Name	No.	Name	No.	Name
6189	Butler, W.	5709	Hammond, E.	4474	Rimmer, T.
5533	Cheeseman, G.	6535	Potter, H. H.	74	Pengelly, W.
702	Player, A. J.	6340	Jones, S. A.	19311	Cantello, H. J.
6286	Davies, P. F.	6208	Sage, J. W.	195	Corston, H. R.
265	Clarke, H. E.	16503	McKinley, A.	6492	Leggett, A. T.
6649	Alcock, H.	6469	Row, H.	17475	Lannon, P. J.
6371	Vine, C. H.	6051	Richards, W.		
12536	Bethell, B.	4332	Jacks, R. H.		

To be advanced to the Fourth Rate (at 6d.).

As Orderlies.

No.	Name	No.	Name	No.	Name
9596	Cooper, F.	5786	Burgess, F.	7433	Berryman, H. T.
4499	Browning, S.	7390	Orme, C.	10051	Cooke, F.
4486	Campion, B. R.	10627	Porter, H.	10309	Connah, J.
1570	Gorton, C.	400	Gallagher, P.	10514	Gibson, H.
4464	Sewell, F. J.	7529	Capel, J. W.	10339	Caton, J.
392	Sparks, J.	6971	Collier, G. E.	10397	Dawes, T.
10718	Stone, R. F.	12641	Hurst, A. H.	10348	Gibbins, C. J.
10642	Allan, H.	7799	McCord, S.	10859	Sibley, W. J.
7708	Earl, A. A.	4723	Samson, W.	18049	Bloomfield, O. G.
18652	Playle, T.	6399	Taylor, B. L.	19027	Higham, J.
6791	Fletcher, J.	16374	Barney, E. H.	456	McMillan, T.
1188	Doyle, M.	20148	Bell, E. J. S.	708	Owen, A.
19116	Dodghson, T.	6537	Bedford, F. A.	842	Parsons, S.
5302	Hayter, J. W.	20407	Bryan, T. W.	2745	Martin, C.
3109	Rice, S.	20462	Chadwick, A.	6262	Lovegrove, E. H. J.
6114	Love, G. G.	16349	Christie, G.	6785	Norrie, C.
3491	Marston, W.	17715	Claydon, G.	1320	Johnstone, W.
2555	Molloy, T.	209	Croxford, C.	10066	Clarkson, A.
28	Bracken, J.	17782	Curry, H.	19273	Groessel, G.
3232	Smyth, J.	20610	Elliott, W. A.	5199	Kitts, H. H.
10679	Upfold, L. A.	4883	Long, J. W.	7220	Shipley, F. S.
18653	Flower, F.	7328	Manning, J.	20765	Werry, T. J.
16427	Brennan, G.	6129	McDermott, J.	2779	Williams, G. H.
15907	Ashbrook, C. H.	7864	Merrill, C. C.	3904	Weale, J.
7778	Walton, T.	2845	Moore, F.	19114	Bindley, J.
10459	Murphy, J.	5519	Nicolle, W.	17494	Peckham, F.
2971	Jones, H. W.	7754	Reast, A. W.	6422	Cowie, J.
4318	Hayes, W.	10800	Simpson, H.	6663	Pickersgill, E.
6105	Norris, S.	4633	Sowden, C.	7295	Proud, E. E.
1756	Connolly, F. P.	136	Wood, C. H.	6266	Wrench, A. E.
20562	Hall, G. E.	4492	Edgar, R.	2754	Lindsay, E.
2025	Dawson, S.	10043	Loxley, E. A.	4753	Howell, R. H.
3792	Bravery, J. W.	4538	West, J. B. T.	9978	Bravington, R. J.
7831	Miller, S.	861	Matheson, A.		

As Clerks.

10694	Elliott, R. S.	7144	Cooper, E. P.	5876	Tait, W.
20360	Lowes, J. W.				

As Cooks.

6117	Higgins, A.	5580	Hawton, J. T.	5666	West, H. D. M.

The advancements are subject to the conditions laid down in paragraph 35 Standing Orders for the Royal Army Medical Corps.

Buglers.

The following boys are appointed Buglers from the dates specified :—
No. 10595 Boy C. A. Ashford, June 16, 1915.
No. 12491 Boy G. M. B. Smith, June 23, 1915.

RE-POSTING TO CORPS.

The undermentioned N.C.O. rejoined the Corps on the date specified :—
No. 7564 Staff-Serjeant W. Ward, November 5, 1914, from Territorial Force.

PROMOTIONS CANCELLED.

(*a*) The promotion to the rank of Corporal notified in Corps Order No. 55 dated December 12, 1914, and to the rank of Serjeant in Corps Order No. 2 dated January 25, 1915, of No. 6392 E. A. Spurgeon is hereby cancelled as it has now been unofficially reported to the War Office that he died at the Battle of Mons.

(*b*) The promotion to the rank of Serjeant notified in Corps Order No. 51 dated June 21, 1915, of No. 18029 Corporal A. L. Burr is hereby cancelled.

ADVANCEMENT CORPS PAY CANCELLED.

(*a*) The advancement of the undermentioned Private to the 3rd rate of Corps pay as orderly, notified in Corps Order No. 54 dated June 21, 1915, is hereby cancelled :—

No. 18719 Walker, S. F.

(*b*) The advancement of the undermentioned Private to the 4th rate of Corps pay as orderly, notified in Corps Order No. 54 dated June 21, 1915, is hereby cancelled :—

No. 6965 Ness, E. R.

AMENDMENTS—CORPS ORDERS.

(*a*) In Corps Order No. 2, dated January 25, 1915, under the heading "To be Serjeant Major," the promotion of No. 12522, Quartermaster Serjeant S. Gallie, is antedated (without back pay) to August 10, 1914, with seniority next below No. 12058 Serjeant Major A. W. Pettley. (*War Office letter No.* 18/*R.A.M.C.*/786 (*A.M., DI.*) *dated* July 24, 1915).

(*b*) In Corps Order No. 18 dated March 6, 1915, the Corps number of Lance Serjeant H. Johnson, promoted to be Serjeant, should read 19385 and not 19383.

NON-EUROPEAN SECTION, R.A.M.C., ADVANCEMENT OF PRIVATES (CORPS PAY).

The following advancements in rate of Corps Pay will take effect from July 28, 1915.

TO BE ADVANCED TO THE THIRD RATE (AT 8d.).

As Orderly.

No. 15 Adams, J.

TO BE ADVANCED TO THE FOURTH RATE (AT 6d.).

As Orderly.

No. 16 Atkinstall, R. I.

NOTICE.

COOKING SECTION.

It is notified for general information that approval has been given for the modification, during the war, of the system of training for cooks laid down in Appendix 7 Standing Orders, R.A.M.C., on the following conditions :—

(1) COOKS IN MILITARY HOSPITALS.—Men who have been employed as cooks for more than three months may, if considered efficient, be examined by a Regular Officer of the unit and a Superintending Cook if available, and if they pass the examination will be eligible for registration as cooks in Military Hospitals, and for advancement to the 4th rate of Corps Pay.

(2) Superintending Cooks in Military Hospitals.—Selected men who are considered likely to be suitable for the position may be sent for instruction in accordance with Appendix 7 to a General Hospital for at least three months. For this purpose all general hospitals will be considered, for the duration of the War, as eligible to hold classes of instruction in the same manner as the hospitals referred to in paragraph 361 Standing Orders R.A.M.C.

(Authority No. 103/Miscellaneous/359 (A.M.D.I.), dated War Office July 6, 1915).

Examinations in the case of cooks in Military Hospitals may be oral and practical only, but for Superintending Cooks the procedure laid down in paragraph 379-384 Standing Orders, R.A.M.C., should be followed.

TERRITORIAL FORCE.

1st *London* (*City of London*) *Generat Hospital*—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Alfred B. P. Smith; Lionel G. Crossman, M.B.; Martin W. K. Bird; Arnold W. Slott, and to remain seconded.

1st *London General Hospital.*—The date of the appointment of Lieutenant John Duncan Legge Currie is June 17, 1915, and not as stated in the *London Gazette* of August 7, 1915.

1st *London* (*City of London*) *Sanitary Company.*—John Oglethorpe Wakelin Barrett, M.B., to be Lieutenant, dated June 25, 1915; Major Greenwood to be Lieutenant, dated August 9, 1915; Percival Hartley to be Lieutenant, dated August 10, 1915. The date of appointment of Lieutenant Norman A. Dore is June 29, 1915, and not as stated in the *London Gazette* of August 5, 1915. The date of appointment of Lieutenant Horace G. Moss is June 29, 1915, and not as stated in the *London Gazette* of August 5, 1915. Lieutenant James E. Wilson, M.D., from the 3rd North Midland Field Ambulance, to be Lieutenant, dated August 22, 1915. Cadet George Leslie Matthews, from the University of London Contingent, Senior Division, Officers Training Corps, to be Lieutenant, dated August 28, 1915. Ernest Romney Matthews to be Lieutenant, dated August 28, 1915.

2nd *London* (*City of London*) *General Hospital.*—The undermentioned Lieutenants to be Captains: Cyril E. Petley, dated April 1, 1915; Leonard Milton, dated April 1, 1915; Herbert Sharpe, dated April 1, 1915; Kenneth B. Clarke, dated August 1, 1915.

2nd *London* (*City of London*) *Field Ambulance.*—Transport Officer and Honorary Lieutenant Arthur D. Don resigns his commission, dated August 26, 1915; Lieutenant Charles Eustace Williams, from the 3rd London (City of London) Field Ambulance to be Lieutenant, dated August 28, 1915.

2nd *London Sanitary Company.*—Serjeant Thomas Jenkins Murray, from 3rd North Midland Field Ambulance, to be Lieutenant, dated August 7,1915.

3rd *London General Hospital.*—The undermentioned Lieutenants to be Captains and to remain seconded, dated April 1, 1915: George H. D. Webb, Edward Smeed, Walter Henry Lloyd to be Lieutenant, dated August 12, 1915. The undermentioned Lieutenants are seconded for duty with the 1st Highland Field Ambulance, dated August 31, 1915: John St. A. Titmas, Harry A. Lucas, John B. Rawlins, Philip W. Green.

4th *London General Hospital.*—Major William A. Turner, M.D., is seconded, dated May 26, 1915.

4th *London Field Ambulance.*—William Morgan Langdon to be Lieutenant, dated August 28, 1915. Edgar Alfred Lambert to be Transport Officer, with the honorary rank of Lieutenant, dated July 28, 1915.

London Mounted Brigade Field Ambulance.—Captain Hugh S. Beadles to be temporary Major, dated June 1, 1915.

London Sanitary Company.—Lieutenant Vincent P. Norman to be Captain, dated August 5, 1915.

Scottish Horse Mounted Brigade Field Ambulance.—Cadet Francis Murray Halley, from the Edinburgh University Contingent, Senior Division, Officers Training Corps, to be Lieutenant, dated July 10, 1915.

2nd *Scottish General Hospital.*—The undermentioned officers are seconded, dated September 10, 1915: Lieutenant-Colonel Charles W. Cathcart, M.B., F.R.C.S.; Lieutenant-Colonel Sir Robert W. Philip, M.D.; Major David Wallace, C.M.G., M.B.,

F.R.C.S. ; Major Francis D. Boyd, C.M.G., M.D. ; Captain Alexander Miles, M.D., F.R.C.S. ; Captain John W. Dowden, M.D., F.R.C.S. ; Captain Archibald A. S. Skirving, C.M.G., M.B., F.R.C.S. ; Captain James G. Cattanach, M.B. ; Captain John Eason, M.D. ; Captain W. Simpson, M.D. ; Captain Edwin Matthew, M.B.

4th Scottish General Hospital.—Major Duncan O. MacGregor, M.B., resigns his commission on account of ill-health, dated June 30, 1915.

Highland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915 : George G. Middleton, M.B. ; Evan A. Mackenzie ; Thomas E. Roberts, M.D. ; Transport Officer and Honorary Lieutenant Charles Riggall resigns his commission, dated August 24, 1915.

1st Highland Field Ambulance.—Captain Arthur Kellas, M.B., to be temporary Major, dated January 14, 1915 ; Lieutenant William H. E. Brand to be Captain, dated April 7, 1915; Major James Robertson, M.D., to be temporary Lieutenant-Colonel, dated May 1, 1915 ; Alfred Bell Whitton, M.B. (late Lieutenant Colonel, 6th Battalion, Gordon Highlanders), to be Captain (temporary), dated June 25, 1915 ; Captain George Dick, M.B., from the Sanitary Service, to be Captain, dated September 11, 1915.

2nd Highland Field Ambulance.—Lieutenant Thomas S. Slessor, M.B., to be Captain, dated June 18, 1915. The undermentioned to be Lieutenants, dated August 12, 1915: Alexander Main Baillie; Harry Gordon Donald, John William McKeggie; Cadet James Alexander Seller, from the Aberdeen University Contingent, Senior Division, Officers Training Corps; William Charles Davidson Wilson.

3rd Highland Field Ambulance.—The date of appointment of Lieutenant Alexander B. Jamieson, M.B., is June 1, 1915, and not as stated in the *London Gazette* of June 7, 1915.

Lowland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains : Andrew R. Muir, M.B., dated April 1, 1914 ; Hugh Forest, M.B., dated April 1, 1915 ; Andrew M. Young, M.B., dated May 4, 1915 : Edward N. Thomson, M.B.; dated June 11, 1915.

Lowland Field Ambulance.—Lieutenant Robert A. Lennie, M.B., to be Captain, dated June 30, 1915 ; Lieutenant Colin C. Philip, M.B., to be Captain, dated July 13, 1915 ; the undermentioned Lieutenants to be Captains, dated April 1, 1915 : James R. Menzies, M.B. ; William H. Armistead, M.B.

1st Lowland Field Ambulance.—Ernest Switzer Forde (late Captain, 5th (Dumfries and Galloway) Battalion, The King's Own Scottish Borderers, to be Major (temporary), dated July 16, 1915 ; James Stark Linton to be Quartermaster, with the honorary rank of Lieutenant, dated August 28, 1915.

2nd Lowland Field Ambulance.—Harry Taylor Findlay, M.B., to be Lieutenant, dated August 10, 1915.

3rd Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915 : Robert B. Barnetson, M.B. ; James A. Henderson, M.B.

1st Northumbrian Field Ambulance.—Major Edward Turton, M.D., to be temporary Lieutenant-Colonel, dated September 11, 1915.

3rd Northumbrian Field Ambulance.—Patrick Joseph Sheedy to be Lieutenant, dated July 31, 1915 ; Captain Francis R. Eddison, from Attached to Units other than Medical Units, to be Captain, dated September 11, 1915 ; John Austin Lee Magee (late Second Lieutenant, 10th (Service) Battalion, The Durham Light Infantry), to be Lieutenant, dated September 11, 1915.

West Riding Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Robert G. Dixon, M.B., dated April 1, 1915 ; Hubert W. Symons, M.B., dated April 1, 1915 ; Frederick P. Gibson, M.B., dated April 23, 1915 ; Hubert T. Bates, M.B., dated April 23, 1915 : Jeffrey W. Malim, M.B., dated April 23, 1915 ; David R. Cramb, M.B., dated April 23, 1915 : George P. P. Clapham, dated April 23, 1915; Arthur S. Hebblethwaite, M.B., dated June 30, 1915 ; Charles M. Gozney, M.B., dated July 1, 1915

1st West Riding Field Ambulance.—Lieutenant Edwin S. G. Fowler to be Captain, dated June 25, 1915.

2nd West Riding Field Ambulance.—Lieutenant Craufurd T. Matthews, M.B., to be Captain, dated April 1, 1915 ; Lieutenant Digby Wrangham Hardy, M.B., to be Captain, dated June 27, 1915.

3rd West Riding Field Ambulance.—Captain William J. Gray, from Attached to Units other than Medical Units, to be Captain, dated August 25, 1915.

Yorkshire Mounted Brigade Field Ambulance.—Lieutenant William H. N. White, M.B., to be Captain, dated May 2, 1915.

2nd East Lancashire Field Ambulance.—Ernest Lionel Forward to be Lieutenant, dated June 30, 1915; Arthur William Havard, M.B., to be Lieutenant, dated June 30, 1915.

1st West Lancashire Field Ambulance.—Captain Richard S. Taylor, M.B., F.R.C.S., to be temporary Major, dated May 29, 1915; the following announcement is substituted for that which appeared in the *London Gazette* of July 19, 1915: Captain William H. Broad, M.D., 6th (Rifle) Battalion, The King's (Liverpool Regiment), to be Captain (temporary), dated May 26, 1915.

2nd West Lancashire Field Ambulance.—Quartermaster-Serjeant William Holden Emblem, from the 3rd West Lancashire Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated September 11, 1915.

Notts and Derby Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Lewis Moysey, M.B., dated April 22, 1915; William A. Brechin, M.B., dated June 16, 1915; Frank Standish, dated June 25, 1915; the appointment of John Wootton Rammell as Lieutenant bears date June 21, 1915, and not as stated in the *London Gazette* of July 20, 1915; David William Griffiths to be Lieutenant, dated July 27, 1915.

1st North Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: Hugh A. Macmillan, M.B., dated April 20, 1915; Matthew T. Ascough, dated April 22, 1915; Thomas S. Elliot, dated April 28, 1915; Alexander Fordyce, M.B., dated May 7, 1915; Arthur Heath, M.D., F.R.C.S., dated May 24, 1915.

2nd North Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: Henry P. Malcolm, M.B., dated May 10, 1915; Robert J. McConnell, M.B., dated May 10, 1915; Edward C. T. Emerson, M.B., dated May 19, 1915; Joshua Buchanan McLean, M.B., to be Lieutenant, dated August 19, 1915.

3rd North Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: Charles C. Grummit, dated April 12, 1915; John G. J. Green, dated April 19, 1915; James E. S. Smith, M.B., dated July 22, 1915; George F. Denning, dated July 23, 1915; Bertram M. Footner, from Attached to Units other than Medical Units, to be Captain, dated August 24, 1915.

North Midland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: John B. Stanley, dated April 1, 1915; Samuel Acheson, M.B., dated April 26, 1915: Sydney Alan Stormer Malkin to be Lieutenant, dated August 5, 1915.

North Midland Casualty Clearing Station.—Albert Richard Henchley, M.D. (late Major, 2nd Home Counties Field Ambulance), to be Major (temporary), dated July 14, 1915.

1st South Midland Mounted Brigade Field Ambulance.—Lieutenant James H. Wilkinson to be Captain, dated April 19, 1915; Lieutenant George C. Soutter, M.D., to be Captain, dated May 3, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of July 12, 1915:—Captain Frederic E. France, M.B., from Attached to Units other than Medical Units, to be Captain, dated May 27, 1915; Major Thomas Henderson Forrest, M.B., to be Lieutenant-Colonel, dated August 11, 1915.

2nd South Midland Mounted Brigade Field Ambulance.—Lieutenaut Alfred G. Levy, M.B., to be Captain, dated August 1, 1915; Lieutenant Alexander Rodger, M.B., to be Captain, dated August 14, 1915; Lieutenant John C. S. Dunn to be Captain, dated August 27, 1915.

3rd South Midland Field Ambulance.—Lieutenant Frank T. Boucher to be Captain, dated April 1, 1915; William George McKenzie to be Lieutenant, dated August 14, 1915; Henry Neville Crowe, M.D., to be Lieutenant, dated September 11, 1915.

Welsh Field Ambulance.—Captain Henry J. Dunbar, M.B., to be temporary Major, dated April 30, 1915; Lawrence Stephenson to be Quartermaster, with the honorary rank of Lieutenant, dated July 25, 1915.

Welsh Border Mounted Brigade Field Ambulance.—Haldane Carson Gilmore to be Lieutenant, dated July 11, 1915.

1st Welsh Field Ambulance.—John Cook (late Second Lieutenant, 4th Welsh Brigade, Royal Field Artillery) to be Captain (temporary), dated July 2, 1915.

South Wales Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Archibald J. Campbell, dated April 1, 1915; Ernest L. Sandiland, M.B., dated April 1, 1915; Martin Scales, dated April 21, 1915; Lieutenant John A. Cooke to be Captain, dated June 26, 1915.

1st East Anglian Field Ambulance.—Lieutenant Arthur W. Paterson, M.B., to be Captain, dated May 29, 1915.

2nd East Anglian Field Ambulance.—The surname of Lieutenant Arthur Greene, M.D., F.R.C.S., is as now stated, and not as announced in the *London Gazette* of July 20, 1915.

3rd East Anglian Field Ambulance.—Lieutenant William R. M. Turtle, M.B., to Captain, dated April 1, 1915; Lieutenant Sigismund H. Rentzsch to be Captain, dated June 24, 1915; Major Henry A. Ridyard, from Attached to Units other than Medical Units, to be Major, dated July 10, 1915; Major Henry A. Rudyard to be temporary Lieutenant-Colonel, dated July 10, 1915.

1st Northern General Hospital.—The undermentioned Lieutenants to be Captains, dated August 9, 1915: Frederick J. Nattrass, M.B., Sydney Thompson, M.B.

2nd Northern General Hospital.—Ethelbert Rest Flint to be Lieutenant, dated August 10, 1915.

4th Northern General Hospital.—Lieutenant-Colonel George H. Grimoldby resigns his commission on account of ill-health, dated September 11, 1915.

1st Southern General Hospital.—George Joughin, M.B., to be Lieutenant, dated July 21, 1915; Koch Harry Gill, M.B., to be Lieutenant, dated July 21, 1915; Geoffrey Legh Wilkinson to be Lieutenant, dated September 3, 1915.

2nd Southern General Hospital.—Major Arthur B. Prowse, M.D., F.R.C.S., to be temporary Lieutenant-Colonel, dated July 10, 1915; Lieutenant Robert J. Irving, M.B., F.R.C.S., to be Captain, dated July 19, 1915.

Eastern General Hospital.—The undermentioned Lieutenants to be Captains, dated April 1, 1915; John H. Owens, Ffrangcon Roberts.

1st Eastern General Hospital.—Serjeant-Major Charles Edward Wilkin Coe to be Quartermaster, with the honorary rank of Lieutenant, dated August 14, 1915.

Wessex Divisional Sanitary Section.—Arthur Ernest Bonham to be Lieutenant, dated August 12, 1915.

1st Wessex Field Ambulance.—Lieutenant Frank A. Roper, M.B., to be Captain, dated April 1, 1915; Lieutenant Alfred J. H. Iles to be Captain, dated April 1, 1915; Lieutenant George D. Perry resigns his commission on account of ill-health, dated September 11, 1915.

2nd Wessex Field Ambulance.—Lieutenant Angus Cameron, M.B., from Attached to Units other than Medical Units, to be Lieutenant, dated May 8, 1915; Major Harry C. Parsons to be temporary Lieutenant-Colonel, dated August 25, 1915.

South Western Mounted Brigade Field Ambulance.—Lieutenant Philip W. Mason, M.B., to be Captain, dated April 3, 1915: Lieutenant Harold Burnet Porteous, M.B., to be Captain, dated April 2, 1915; Lieutenant Bertram Michell Young, to be Captain, dated April 16, 1915.

1st South Western Mounted Brigade Field Ambulance.—Hugh Wansey Bayly (late temporary Surgeon, Royal Navy) to be Captain (temporary), dated September 4, 1915.

2nd South Western Mounted Brigade Field Ambulance.—Lieutenant Louis J. E. McHugh, M.B., to be Captain, dated April 6, 1915.

1st Western General Hospital.—The seconding of Captain Keith W. Monsarrat, M.B., which was announced in the *London Gazette* of May 20, 1915, is cancelled; Major Claude Rundle, M.D., to be temporary Lieutenant-Colonel, dated August 11, 1915.

2nd Western General Hospital.—Graham Miles Benton, M.B., to be Captain, whose services will be available on mobilization, dated June 14, 1915; James Gladstone McKinlay, M.B., to be Lieutenant, dated June 14, 1915; Edward Moir to be Captain, whose services will be available on mobilization, dated August 1, 1915.

3rd Western General Hospital.—Rhys Trevor Jones to be Lieutenant, dated June 16, 1915; Cornelius Charles Boyle, M.B., to be Lieutenant, dated June 20, 1915; John Thomas Williams, M.D., to be Lieutenant, dated June 30, 1915; Serjeant-Major Charles Hayward to be Quartermaster, with the honorary rank of Lieutenant, dated August 24, 1915.

3rd Home Counties Field Ambulance.—Captain Augustine Griffith, M.D., from the Sanitary Service, to be Captain, dated August 31, 1915; Corporal Stanley Stephens Eyre, from the West Kent (Queen's Own) Yeomanry, to be Transport Officer, with the honorary rank of Lieutenant, dated September 7, 1915; Major Hector G. G. Mackenzie, M.D., to be temporary Lieutenant-Colonel, dated September 11, 1915; Captain William D. Sturrock, M.D., to be temporary Major, dated September 11, 1915.

Home Counties Casualty Clearing Station.—William Maskelyne Parham, M.D. (late Surgeon-Captain, 1st Volunteer Battalion, Princess Charlotte of Wales's (Royal Berkshire Regiment), to be Captain, dated September 4, 1915.

ATTACHED TO UNITS OTHER THAN MEDICAL UNITS.

Lieutenant Harry M. Soden, from the 3rd Welsh Field Ambulance, to be Lieutenant, dated December 15, 1914.

Major Frederick J. Oxley, from the 17th Battalion, the London Regiment, to be Major, dated September 2, 1915.

Lieutenant George B. Forge to be Captain, dated April 1, 1915.

Lieutenant John Saffley, M.B., to be Captain, dated April 1, 1915.

Lieutenant Francis R. Eddison to be Captain, dated April 1, 1915.

Lieutenant Stephen O. Dolan to be Captain, dated April 1, 1915.

Lieutenant Ernest E. B. Landon to be Captain, dated April 1, 1915.

Lieutenant Charles E. Anderson to be Captain, dated April 1, 1915.

Lieutenant Reginald C. Neil to be Captain. dated April 1, 1915.

Lieutenant Charles J. Fox to be Captain, dated April 1, 1915.

Lieutenant Hastings F. Everett to be Captain, dated April 1, 1915.

Lieutenant Jesse R. Garrood, M.D., to be Captain, dated April 1, 1915.

Lieutenant George Candler to be Captain, dated April 5, 1915.

Arthur Benjamin Winder, M.D., to be Lieutenant, dated June 1, 1915.

Lieutenant William Love to be Captain, dated April 12, 1915.

Lieutenant Edward L. Martin, M.D., to be Captain, dated April 15, 1915.

Lieutenant John J. Weaver to be Captain, dated April 15, 1915.

Lieutenant Frederick E. France, M.B., to be Captain, dated April 27, 1915.

Lieutenant Austen A. Bearne to be Captain, dated May 1, 1915.

Lieutenant Walter Smartt, F.R.C.S.I., to be Captain, dated August 11, 1915.

Leonard Stephen Willox, M.D., to be Lieutenant, dated August 5, 1915.

Lieutenant Samuel Rutherford, M.B., to be Captain, dated June 10, 1915.

Lieutenant Hugh G. Bruce, M.B., to be Captain, dated July 24, 1915.

Lieutenant James McGavin Deuchars, M.B., to be Captain, dated August 4, 1915.

Captain Charles A. C. Smelt, M.B., to be Major, dated May 27, 1915.

Surgeon-Major John Nightingale, M.D., from the 1st West Riding Brigade, Royal Field Artillery, to be Major, dated September 7, 1915.

Lieutenant Frederick Hunton, M.D., to be Captain, dated June 17, 1915.

Frederick Arthur Pring to be Lieutenant, dated August 19, 1915.

Wilfred Percy Tindal Atkinson to be Lieutenant, dated August 20, 1915.

Captain Owen W. D. Stell, from the 3rd Battalion, The Monmouthshire Regiment, to be Captain, dated September 10, 1915.

Lieutenant Hugh A. McLean, M.B., to be Captain, dated June 6, 1915.

Captain Thomas D. Laird, M.B., to be Major, dated August 1, 1915.

Captain Thomas Douglas Brown, M.B., to be Major, dated August 5, 1915.

Lieutenant Sydney Oliphant Bingham, from the 14th (Reserve) Battalion, The Sherwood Foresters (Nottinghamshire and Derbyshire Regiment), to be Lieutenant, dated August 22, 1915.

The undermentioned Lieutenants to be Captains :—

Alexander Ambrose, M.D., dated April 1, 1915.

Ernest S. Stork, M.B., dated April 1, 1915.

William A. Robertson, dated April 1, 1915.

Alexander G. V. Van Someren, M.B., dated April 1, 1915.

Maurice C. Anderson, dated April 1, 1915.

Reginald D. Gawn, M.B., dated April 1, 1915.

John C. McKenzie, M.B., dated April 1, 1915.

George H. Dominy, dated April 9, 1915.

John A. Thomson, M.B., dated April 24, 1915.

Archibald N. S. Carmichael, M.B., dated April 27, 1915.

Ernest B. Keen, dated May 1, 1915.

Harold F. L. Hugo, M.B., dated June 19, 1915.

John W. M. Jamieson, M.B., dated June 21, 1915.
Thomas Rhind, dated June 28, 1915.
William H. Date, M.D., dated August 6, 1915.

Captain Thomas E. Roberts, M.D., from the Highland Mounted Brigade Field Ambulance, to be Captain, dated July 26, 1915.

Lieutenant George B. H. Jones, M.D., to be Captain, dated April 1, 1915.

Lieutenant William E. L. Elliott, M.D., to be Captain, dated April 1, 1915.

Lieutenant Charles A. Sampson to be Captain, dated May 16, 1915.

Lieutenant Robert L. Guthrie, M.D., to be Captain, dated June 15, 1915.

Lieutenant Joseph B. McKay resigns his commission on account of ill-health, dated August 13, 1915.

Captain Owen W. D. Steel, from the 3rd Battalion, the Monmouthshire Regiment, to be Captain, dated September 10, 1915.

The seconding of Captain Haldinstein D. Davis, which was announced in the *London Gazette* of November 13, 1914, is cancelled.

TERRITORIAL FORCE RESERVE.

Royal Army Medical Corps.

Cadet Alexander Louis Cameron Mackenzie, from the Aberdeen University Contingent, Officers Training Corps, to be Lieutenant (on probation), dated August 20, 1915.

Ex-Cadet John Taylor Scrogie, M.B., from the Aberdeen University Officers Training Corps to be Lieutenant (on probation), dated July 31, 1915.

Ex-Cadet Alan Rupert Laurie, M.D., from the Edinburgh University Contingent, Officers Training Corps, to be Lieutenant (on probation), dated August 1, 1915.

Captain Owen Wilson, M.B., resigns his commission, dated July 16, 1915.

Temporary Lieutenant Kenneth Alexander Maclean, M.B., from Royal Army Medical Corps, to be Captain, dated August 16, 1915.

The undermentioned Lieutenants to be Captains :—
William J. Reid, M.B., dated April 1, 1915.
Ronald W. Duncan, dated July 10, 1915.
William L. E. Reynolds, dated August 1, 1915.
Frank C. Harrison, dated August 3, 1915.
William K. Campbell, M.B., dated August 6, 1915.
Charles M. G. Campbell, dated August 8, 1915.
Owen G. Parry Jones, dated August 8, 1915.
Eris S. Mawe, dated August 9, 1915.
William B. Jepson, dated August 12, 1915.
Edward W. Mann, M.B., dated August 13, 1915.
Thomas D. Inch, M.B., dated August 15, 1915.
Gerald F. V. Leary, M.B., dated August 16, 1915.
Sidney W. Lund, M.B., dated August 16, 1915.
Noel H. W. Saw, dated August 20, 1915.
Henry R. Sheppard, dated August 22, 1915.
Donald C. Macdonald, M.B., dated August 22, 1915.
William T. Hare, dated August 24, 1915.

Herbert Troughton Chatfield, M.B., to be Lieutenant (on probation), dated August 20, 1915.

The undermentioned Lieutenants (on probation) are confirmed in their rank :—
Douglas C. Pim, M.B.
Norman L. Reis, M.B.
William J. Dowling, M.B.
Frederick R. S. Shaw, M.B.
Cyril E. H. Gater.
Charles H. Brennan.
Samuel D. Lodge.
Arthur J. Beveridge, M.B.
John G. Hendry, M.B.
Ribton G. Blair, M.B.
George Stanton, M.B.
John D. Proud, M.B.
John A. Musgrave.
Charles M. G. Campbell.
James McKay, M.B.

DEATHS.

JONES.—On August 30, at Bryn Tirion, Church Walks, Llandudno, Colonel John Matthew Jones, A.M.S., late A.D.M.S. Plymouth District. Invalided whilst on active service.

FLEMING.—Brigade Surgeon Lieutenant-Colonel Joseph Fleming, M.D., F.R.C.S.Edin., retired, Army Medical Staff, died at Castlequarter, Inch, Londonderry, on August 10, 1915, aged 75.

LAMPREY.—Lieutenant-Colonel Joseph John Lamprey, retired, Army Medical Staff, died at 1, Schubert Road, Southfields, London, S.W., on September 6, 1915, aged 66.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

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	16	0 12 0	0 5 3				
100	4	0 5 6	0 2 9				
	8	0 9 0	0 4 4	6 6	3 3	5 6	2 0
	16	0 16 9	0 6 9				
200	4	0 8 6	0 4 0				
	8	0 13 6	0 6 0	9 0	6 3	7 6	4 0
	16	1 3 6	0 8 9				

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Covers, 1s. 4d. net; binding, 1s. 2d.

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In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Sir G. Makins, Colonel W. W. Pike, D.S.O., Lieutenant-Colonel F. C. Heffernan, Major F. W. Cotton, P. Sargent, Major F. A. H. Clarke, G. Holmes, Captain J. Oliver Hamilton, Lieutenant C. Clarke, James Rae, Lieutenant J. S. Goodacre.

The following publications have been received:—

British: Tropical Diseases Bulletin, Medical Press and Circular, The Journal of Tropical Medicine and Hygiene, The Lancet, The Hospital, The Indian Medical Gazette, Journal of the Royal United Service Institution, The Journal of State Medicine, The Medical Journal of South Africa, The Royal Engineers' Journal, St. Bartholomew's Hospital Journal, Medical Journal of Australia, The Sanitary Record and Municipal Engineering, The Medical Review, The Practitioner, Red Cross and Ambulance News, The Army Service Corps Journal, Australian Military Journal, Guy's Hospital Gazette, The Indian Journal of Medical Research.

Foreign: Annali di Medicina Navale e Coloniale, Russian Naval Medical Journal, Bulletin de l'Institut Pasteur, Bulletin of the Johns Hopkins Hospital, Revista de Sanidád Militar, United States Naval Medical Bulletin, The Military Surgeon, Le Caducée.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

August and September, 1915.

War Office,
September 15, 1915.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned Officers to be Companions of the Distinguished Service Order, in recognition of their gallantry and devotion to duty in the Field:—

Captain Hugh Glencairn Monteith, Royal Army Medical Corps (attached 2nd Battalion, The Duke of Cornwall's Light Infantry).

For conspicuous gallantry and devotion to duty in picking up and attending to the wounded under heavy fire in the actions near St. Jean and Wieltje, east of Ypres, between April 23 and 27, 1915, when the casualties in the battalion to which he was attached were very heavy.

Lieutenant William Brooks Keith, M.B., 1st Home Counties Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry at Hooge, on the night of April 23 and 24, 1915. When a shell killed two stretcher-bearers who were bringing in a wounded officer, he went out to assist, and under heavy fire brought the wounded officer into the dressing station.

He has performed many acts of a like nature, and has consistently shown coolness and resource under fire.

Captain Kingsmill Williams Jones, M.D., Royal Army Medical Corps (Special Reserve), attached 1st Battalion, East Kent Regiment.

For conspicuous gallantry and devotion to duty at Hooge. During the entire night of August 9 and 10, 1915, and the whole of the following day and night he was attending to and evacuating wounded from the front trenches, time after time exposing himself to shell and rifle fire. He was twice slightly wounded, but stuck to his work with unflagging energy. It was entirely owing to Captain Jones that the crater was successfully evacuated of wounded.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officer in recognition of his gallantry and devotion to duty in the Field:—

Temporary Lieutenant Thomas Lewis Ingram, Royal Army Medical Corps, attached 1st Battalion, The King's (Shropshire Light Infantry).

For conspicuous devotion to duty and energy at Hooge. He was evacuating wounded from the front trenches almost without cessation the entire nights of August 9 and 10, 1915, and his indomitable energy and resource were the means of saving the lives of many severely wounded officers and men. He has previously done consistently good work.

ARMY MEDICAL SERVICE.

The undermentioned temporary Colonels to be temporary Surgeon-Generals :—

Dated September 26, 1915.—Sir George H. Makins, K.C.M.G., C.B., F.R.C.S. ; Sir Anthony A. Bowlby, Kt., K.C.M.G., F.R.C.S.

Colonel Robert S. F. Henderson, K.H.P., is seconded for service under the Colonial Office, dated July 24, 1915.

ROYAL ARMY MEDICAL CORPS.

The undermentioned to be temporary Lieutenant-Colonels :—

Dated April 28, 1915.—Herbert George Ashwell whilst employed at the Bagthorpe War Hospital.

Dated August 10, 1915.—Temporary Honorary Lieutenant-Colonel Percy Sargent, M.B., F.R.C.S. ; Temporary and Honorary Major Gordon M. Holmes, M.D.

The undermentioned to be temporary Major :—

Dated August 30, 1915.—Robert Thornton Meadows, M.D., late Surgeon-Major, Army Medical Reserve of Officers.

Lieutenant-Colonel Thomas F. Dewar, M.D., from Sanitary Service to be Deputy Assistant Director of Medical Services, Highland Division, dated April 23, 1915.

Second Lieutenant George Min Adam, M.B., from 5th Battalion (Angus and Dundee) (Territorial), The Black Watch (Royal Highlanders), to be temporary Lieutenant, dated April 7, 1915. (Substituted for the notification which appeared in the *Gazette* of May 3, 1915.)

Major Edward H. Myddelton-Gavey, from the Territorial Force Reserve, to be Deputy Assistant Director of Medical Services, 2nd Army, Central Force, dated June 5, 1915.

Lieutenant-Colonel Sir J. R. A. Clark, Bt., C.B., F.R.C.S.Ed., Unattached List, Territorial Force, to be temporary Lieutenant-Colonel whilst in charge of the St. John Ambulance Brigade Hospital, dated July 14, 1915.

Arthur Godfrey Wilkins, M.B., to be temporary Honorary Captain whilst serving with No. 5 British Red Cross Hospital, dated July 26, 1915.

The appointment to a temporary Lieutenancy of Arthur Geoffrey Owen, M.D., notified in the *Gazette* of July 26, 1915, is cancelled.

Major Charles H. Fagge, M.B., F.R.C.S., 2nd London (City of London) General Hospital, to be temporary Honorary Lieutenant-Colonel, and to remain seconded whilst serving with the Hampstead Military Hospital, dated July 28, 1915.

Sir John Collie, Kt., M.D., to be temporary Honorary Major, dated July 30, 1915.

The notification regarding temporary Honorary Lieutenant William F. Thompson, which appeared in the *Gazette* of August 7, 1915, is cancelled.

William Durward Cruickshank, M.B., to be temporary Honorary Lieutenant, dated August 9, 1915.

Temporary Major C. Gordon Watson, F.R.C.S., to be temporary Honorary Lieutenant-Colonel whilst serving with No. 1 British Red Cross Hospital, dated August 11, 1915.

Alexander Robert Ferguson, M.D., to be temporary Major, dated August 12, 1915.

Major Augustus A. W. Merrick, F.R.C.S., from the 3rd West Lancashire Field Ambulance, to be Deputy Assistant Director of Medical Services, 2nd Mounted (Reserve) Division, dated August 14, 1915.

The name of temporary Lieutenant Livingston Gilbert Gunne, M.D., is as now described, and not as stated in the *Gazette* of August 17, 1915.

Major Frederic W. Lamballe, M.B., from the Half-pay List, to be restored to the establishment, dated August 19, 1915.

The undermentioned temporary Lieutenants to be temporary Captains :—

Dated July 17, 1915.—Patrick Hunter Gillies, M.B., late Captain, 8th (Argyllshire) Battalion (Territorial), Princess Louise's (Argyll and Sutherland Highlanders) ; Captain Norval James Watt, M.B., South African Medical Corps.

Dated August 5, 1915.—Thomas H. Pettit, M.B.

Dated August 6, 1915.—Henry William Marett Tims.

Dated August 7, 1915.—Harold John Huchens, D.S.O., late Second Lieutenant Officers Training Corps, and Captain Australian Army Medical Service.

Dated August 16, 1915.—Lionel C. E. Murphy.

Dated August 17, 1915. – Henry C. E. Quin.

Dated August 23, 1915.—James Fairley, M.D.

Dated August 24, 1915.—Howard H. Hepburn, M.D.; Ambrose L. Lockwood, M.D.; John M. Stenhouse, M.B.; Henry William Drew, F.R.C.S.; William G. Davies.

Dated August 25, 1915.—Francis A. Osborn.

Dated August 26, 1915.—Hedley Boyers, M.B.

Dated August 27, 1915.—James B. Cruickshank, M.B.; William Frier, M.B.

Dated August 28, 1915.—Tom Bragg; Frank A. Hampton, M.B.; John I. Johnson: Arthur V. Poyser, M.B.

Dated August 29, 1915.—John F. Barr, M.D.; Geoffrey M. Cowper; Alexander Lundie, M.B.; Lawrence T. Stewart, M.B.; Matthew White, M.B.; Percy E. Adams, M.D.; William B. G. Angus, M.B.

Dated August 31, 1915.—John M. Johnston, M.B.; Herbert C. Lucey, M.D.; Wallis J. Paramore; Douglas B. Spence; Ralph J. Tait, M.B.; Robert F. Young, M.B.

The appointment to a temporary Lieutenancy of Thomas Ewart Ashley is ante-dated to April 26, 1915.

The undermentioned to be temporary Captains:—

Dated August 23, 1915.—Edward Postle Gwyn Causton, late Staff-Surgeon, Royal Navy.

Dated September 1, 1915.—Alma Percy Ford; Alexander Dingwall-Fordyce, M.D.: Horace Dorset Eccles.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated July 13, 1915.—Philip C. P. Cloake relinquishes his commission on account of ill-health.

Dated August 5, 1915.—George S. Sims, M.D.

Dated August 11, 1915.—Moses J. Rowlands, M.D.

Dated August 15, 1915.—Louis D. Cohen.

Dated September 1, 1915.—Roy R. Kerr, M.B.

The undermentioned temporary Captains relinquish their commissions:—

Dated August 4, 1915.—Robert S. Cocke, F.R.C.S.Edin.

Dated August 8, 1915.—W. W. C. Topley, M.B.

Dated August 22, 1915.—Ewen C. Stabb, F.R.C.S.

The undermentioned to be temporary Lieutenants:—

Dated June 10, 1915.—Charles Richard Wills, M.B.

Dated July 6, 1915.—Leslie Burton Burnett, M.B.

Dated July 13, 1915.—John Gordon Thomson, M.B.; Douglas Rodger, M.B., F.R.C.S.Edin.; William Young, M.D., F.R.C.S.Edin.

Dated July 16, 1915.—Thomas Clark Ritchie, M.D.

Dated July 17, 1915.—John Edmund Power, M.B.; Allan Lindsey Saunders; Andrew Peden, M.B.; Arthur Frederick Flower; Kenneth Bernard Pinson, M.B.; Edmund Duncan Franchell Hayes, M.B.; George Oliver Fairclough Alley, M.B.; Frederick Green, M.D.; Sydney Garrat Vinter; Harry Armstrong; John Cecil Fisher, M.B.; Archibald Douglas Hamilton, M.B.; Frederick George Ralston, M.B.; Donald Renton, M.B.; Louis Stephen Shoosmith; Edward Howard Paddison, M.D.; Robert Dow, M.B.; Alan Gibb Crook, M.B.; Neil MacLeod, M.B.; John Mellon Smeaton; Guido De Piro D'Amico, M.D.; Thomas Somerville Reeves; Montagu Travers Morgan, M.B.; Arthur William Baker, M.B.; Philip Vanner Earley, M.B.

Dated July 19, 1915.—James Roy McVail, M.B.; Henry Potter Hall, M.B.; George Buchanan, M.B.; Augustine Fitzgerald Studdert; Geoffrey Ratcliffe Plaister; Alexander Russell Young; Campbell Lamont Miller, M.B.; Edwin Algernon Lindsey; Abraham Zadok Philips, M.D.; Henry Little Hardy Greer, M.B.; Arthur John Wellington Cunningham, M.D.; Fraser McEwen Sinclair, M.B.; James Cook, M.B.; Adam Patrick, M.D.; Frank Beauchamp Martin, M.B., F.R.C.S.; Robert Neville Geach, F.R.C.S.

Dated July 20, 1915.—Joseph Patrick, M.B.; David Glen, M.B; Alexander Gibson, M.B., F.R.C.S.

Dated July 21, 1915.—Charles Bromley Davies; Warrington Yorke, M.D.; James Charles Spillane, M.B.; William Cranfuird McNaghton Dickey; William Cochran Burns, M.D.; Robert Tait McKenzie, M.D.; Herbert Sydney Smith, M.B.

Dated July 22, 1915.—Edward Fullerton, M.B.; Patrick Arthur Sullivan; Donald Trench Skeen, M.B.; William Phillips Jones; Cedric Russell, M.B.; Ralph Rimmer, M.B.; Arthur Cundell Major; Frederick Cecil Holman Piggott, M.D.

Dated July 23, 1915.—George Maxwell Brown, M.B.; William Balfour Gourlay, M.B.; Samuel Patterson Hodkinson, M.B.; Charles James Young, M.B.; David Gould Gardiner, M.B.; Stephen Gerald John Dowling, M.B.; Simon Alexander Kuny, M.B.; Howard Slater, M.D.; Thomas Harold Thomas; John Kilpatrick Stewart, M.B.; John Richmond Bryce, M.D.; Horace Gooch, M.B.

Dated July 24, 1915.—Richard John Attridge, M.D.; Cecil Francis Brady, M.B.; John William Riddoch, M.B.; Arthur Ronald McLachlan, F.R.C.S.; George Kennedy; George Adam, M.B.

Dated July 25, 1915.—Duncan Miller, M.B.; Harry Appleton; William Keverall McIntyre, M.B.

Dated July 27, 1915.—James Barr; Robert Lester Donn; Charles Cyril O'Kell; Reginald Hugh Simpson, M.B.

Dated August 1, 1915.—Sam Todd.

Dated August 4, 1915.—William Brown Dalgleish.

Dated August 6, 1915.—James Davidson, M.B.; Stuart Jasper Cowell; Hugh Llewellyn Glyn Hughes; John Struan Alexander; Thomas Willian Sheldon.

Dated August 7, 1915.—John Crawford Knox, M.B.; Joseph Alan Longley, M.B., F.R.C.S.Edin.; Frederick William Hutchinson Hutchinson; Michael Coghlan, M.B.; Paul MacDonald Little, M.B.; George Maudsley Jackson; Alan Hawkins Morley; Melville Mortimer Adams, M.B.

Dated August 9, 1915.—Norman Blake Laughton, M.B.; Thomas Walter Melhuish; William Durward Cruickshank, M.B.

Dated August 10, 1915.—Brian Whitehead; Hugh McIntyre; Arthur Helmuth John Miller.

Dated August 12, 1915.—James Bennett Tombleson, M.B.

Dated August 14, 1915.—Hugh Frederick Sheldon; Edmund Hughes Flanigan, M.B.; John Cameron Thomson Teggart, M.B.; John Franklin Young, M.B.; William Girdwood, M.B.; F.R.C.S.Edin.: Arthur Philip Woollright; Alfred James Ireland, M.B.

Dated August 20, 1915.—Frank John Hathaway, M.D.; Edward Vincent Williams, M.B.; John Reginald Arthur Digby Todhunter, M.B.; John Lindsay, M.D.; Robert Massie, F.R.C.S.Edin.; James Reid, M.B.; William Vincent Johnstone; Thomas Ayscough Hawkesworth, M.B.; John Caldwell Ferguson; John Wishart Welsh Hewitt, M.B.; William Mason; Donald Cameron MacLachlan, M.B.; William Ramsay Nasmyth, M.D., F.R.C.S.Edin.; William James Dunlop Robertson, M.B.; George Wright, M.B.; John Young, M.B.; John Bain, M.B.; Robert Whitson Telford, M.D.; Maurice Gilbert Hannay; Frank Roland Wallis.

Dated August 21, 1915.—George Walker, M.D.; Alfred Charles Sandston, M.D.; Lawrence Sebastian Morgan, M.B.

Dated August 23, 1915.—Frank Stanley Noble, M.D.; Ralph Davies Smedley, M.D.; John Arthur Gwynn Sparrow, M.B.; John Christopher Davies, M.B.; Duncan Malloch, M.B.; George Douglas MacKintosh; Harry Rathbone Griffith, M.B.; Archibald Todrick, M.B.; James Williamson Martin, M.D.; Arthur Cecil Laing, M.B.; Henry Pierce Cuthbert; Oswald Erasmus Ward; David Harris Jones, M.B.; William Frederick Shanks, M.B.; Arthur Ashmore; Robert Philip Graham; John Ferguson Carruthers, M.D.; William David Bathgate; Henry John Sullings Kimbell; Henry George Jamieson, M.D.; George Agincourt Hodges; James Taylor Kyle, M.B.: Edward Wick MacWilliam, M.B.: Thomas Francis Weakliam, M.B.: Rodolphus Whittaker Harper, M.B.; Edgar Huntley, M.B.; Joseph Stanislaus Doyle, M.B.; George Johnston; David Jackson McAdam, M.B.

Dated August 24, 1915.—Joseph Porter, M.B.; David Marmaduke Gill, M.B.: John Dickie, M.B.; Edward Ratcliffe Holborow, M.B.; Henry Valentine Fitzgerald; Walter Gilmour, M.D.; Emile Horace George Duncan; David McKail, M.D.; Richard Alfred Parsons.

Dated August 25, 1915.—Eugene John McSwiney, M.B.; Andrew William Palethorpe Todd, M.B.: Sidney John Liddon Lindeman; George Munro, M.B.; Alexander Rennie, M.B.; Randal McCarthy.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated August 12, 1915.—Albee Amos Skeels, M.D.

Dated August 20, 1915.—Andrew McConnel Davidson, M.D.; William James Chapman, M.B.; Alexander Ross, M.D.; Dimock Stanley Cassidy, M.D.; David Alexander Volume, M.D.; Bernard Francis, M.D.; Howard Harvey, M.D.: George Perry Armstrong, M.D.: James Thornley Bowman, M.D.; Charles Alexander Fox Gaviller, M.D.; James Frederick Adamson, M.D.: Floyd Cecil Stewart, M.D.; John Ferrell Wood, M.D.; William Edward Ainley, M.D.; George Boyd McTavish, M.D.; John Robert Irwin, M.B.; James Blain Haverson, M.D.: Douglas St. Clair Creighton, M.D.; George Herbert Laurence Armstrong, M.D.; John Alexander Wellwood, M.D.; John Frederick Sadleir; Alexander Russell Munroe, M.D.; Francis Lorne McKinnon, M.D.; David Levern Dick, M.B.

Dated August 26, 1915.—Roderick Maclean : Howell Woodwell Gabe, F.R.C.S.Edin.: Joseph Patrick Dee, M.D. ; James Lyone, M.B. ; George Rae Spence, M.B. ; Dugald Ferguson, M.B.

Dated August 27, 1915.—Thomas Pretsell, M.B. ; Wilfred Barkes, M.D. ; Alexander Whyte Cassie, M.B. ; James Beatty, M.D. ; Robert Percy Weldon ; Reginald Puttock, M.B.

Dated August 28, 1915.—William Thomas Wearing, M.B. ; James Macarthur, M.B. ; Henry St. John Randell, M.B : Andrew Wight, M.B.

Dated August 30, 1915.—Thomas Milling, M.B. ; Herbert Gibbons Ward, M.D. ; Edward Seguier Sowerby, M.B. : Herbert Alfred Bodkin.

Dated August 31, 1915.—George Frederick Gill : George Taylor Gifford, M.D. : Maurice Frederick Bliss ; Thomas Hitchings James ; Augustus Henry Aldridge ; James Crowley.

Francis Percy Young, M.D., to be temporary honorary Lieutenant whilst serving with No. 1 British Red Cross (the Duchess of Westminster's) Hospital, dated July 1, 1915.

Eric Arnold Scott to be temporary honorary Lieutenant, dated July 24, 1915.

The undermentioned temporary Lieutenants relinquish their commissions :—

Dated August 1, 1915.—John J. L. Ferris, M.B.

Dated August 4, 1915.—James B. Anderson, M.B. ; Thomas E. A. Carr, M.B. ; James G. B. Coleman, M.D. ; Edgar Ashby ; John F. Gill, M.B.

Dated August 8, 1915.—Thomas F. Wyse.

Dated August 10, 1915.—Charles S. Atkin ; Cecil K. Attlee ; Edward N. Graham, F.R.C.S. ; Neville C. Wallis ; John Arthur West.

Dated August 11, 1915.—Thomas A. Jones, M.D. ; Andrew B. Lindsay, M.B. ; Charles W. Forsyth, M.B. ; William A. Wilson-Smith, M.D. ; Henry G. Greaves, M.B.

Dated August 14, 1915.—George H. Rodolph.

Dated August 15, 1915.—Stewart R. Douglas.

Dated August 20, 1915.—James Hamilton Fleming relinquishes his commission on account of ill-health.

Dated August 28, 1915.—Edward V. R. Fooks.

Dated August 29, 1915.—John P. Egan.

Dated September 13, 1915.—Arthur W. Hare, M.B., relinquishes his commission on account of ill-health.

Dated August 31, 1915.—Lieutenant J. M. W. Morison relinquishes his temporary honorary commission on ceasing to be employed with No. 6 British Red Cross (Liverpool Merchants' Mobile) Hospital.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant :—

Dated July 24, 1915.—Henry Howell.

Dated July 26, 1915.—Herbert John Willis.

Dated August 26, 1915.—Frederick William O'Connor.

Dated September 6, 1915.—Arthur Bayford Heron ; Oswald Davenport Price.

Quartermaster and Honorary Captain Charles Bere, retired pay, late Royal Army Medical Corps, to be granted the honorary rank of Major ; dated July 15, 1915.

Quartermaster and Honorary Major Thomas Exton, Royal Army Medical Corps, is retained on the Active List under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be Supernumerary ; dated August 11, 1915.

Quartermaster and Honorary Major Harry Godley Hasell, Royal Army Medical Corps, is retained on the Active List under Article 120, Royal Warrant for Pay and Promotion, and to be Supernumerary ; dated August 23, 1915.

Norman Burton to be temporary Quartermaster, Home Hospitals Reserve, with the honorary rank of Lieutenant, dated September 4, 1915.

SPECIAL RESERVE.

Royal Army Medical Corps.

The undermentioned Lieutenants (on probation) are confirmed in their rank : John A. Binning, John E. Rusby.

War Office,
September 10, 1915.

The King has been graciously pleased to confer the Territorial Decoration upon the undermentioned Officers of the Territorial Force, who have been duly recommended for the same under the terms of the Royal Warrant dated August 17, 1908:—

YEOMANRY.

Norfolk (The King's Own Royal Regiment).—Surgeon-Major John F. Gordon-Dill, M.D.

ROYAL HORSE ARTILLERY.

Shropshire.—Surgeon-Major George Mackie, M.B.

ROYAL ARMY MEDICAL CORPS.

2nd South-Western Mounted Brigade Field Ambulance.—Lieutenant-Colonel Arthur Cary.

TERRITORIAL FORCE.

ROYAL ARMY MEDICAL CORPS.

London Mounted Brigade Field Ambulance.—Lieutenant Harold E. Gibson, M.B., to be Captain, dated April 1, 1915.

1st London (City of London) Field Ambulance.—Lieutenant Martin B. H. Stratford, F.R.C.S.Edin., to be Captain, dated April 1, 1915; Eric G. Gauntlett, M.B., F.R.C.S., dated April 1, 1915; Eric Donaldson, dated April 1, 1915; Lieutenant Roger P. Stewart, M.B., to be Captain, dated August 22, 1915.

1st London (City of London) General Hospital.—Lieutenant William F. Thompson resigns his commission on account of ill-health, dated September 26, 1915.

1st London (City of London) Sanitary Company.—The undermentioned Lieutenants to be Captains: Martin Priest, dated April 1, 1915; Evelyn A. Cooper, dated April 1, 1915; George White, dated June 15, 1915; Robert Jacobs, dated June 15, 1915; Robert Robison, dated July 4, 1915; Andrew A. McWhan, M.B., dated July 11, 1915; Charles N. Draycott, dated July 17, 1915; Constant W. Ponder, dated August 1, 1915; William N. W. Kennedy, M.B., dated August 8, 1915.

1st London Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Hubert J. B. Fry, dated April 1, 1915; Arthur H. Pemberton, dated May 10, 1915.

2nd London (City of London) General Hospital.—Captain Louis A. Dunn, M.B., F.R.C.S., resigns his commission on account of ill-health, dated September 25, 1915.

2nd London (City of London) Field Ambulance.—Lieutenant Leonard A. Harwood to be Captain, dated April 1, 1915; Lieutenant Louis Courtauld, M.B., to be Captain, dated April 1, 1915.

2nd London Sanitary Company.—The undermentioned Lieutenants to be Captains: Arthur H. Savage, M.D., dated April 1, 1915; Arthur G. Atkinson, M.B., dated April 2, 1915; James Clayton, dated April 3, 1915; Lieutenant Ashley G. G. Thompson, M.B., to be Captain, dated April 23, 1915; Chartres A. Molony, dated May 28, 1915; Francis S. Carson, M.B., dated May 31, 1915; John Crawford, M.B., dated June 4, 1915; Kenneth MacLennan, dated June 11, 1915; John H. N. Price, dated June 11, 1915; Patrick A. Galpin, M.D., dated June 17, 1915; George G. Johnstone, M.B., dated June 29, 1915; Walter K. Parbury, dated July 1, 1915; John H. Wood, M.B., dated July 1, 1915; George L. Eastes, dated July 8, 1915; George W. Ellis, dated July 12, 1915; Ernest B. Pike, dated July 15, 1915; Gerald Q. Lennane, F.R.C.S., dated July 20, 1915; Osmond Cattlin to be Lieutenant, dated August 20, 1915.

3rd London (City of London) Field Ambulance.—The undermentioned Lieutenants to be Captains: Frank H. Robbins, dated April 1, 1915; Robert E. Barnsley, dated April 1, 1915; Julian Taylor, F.R.C.S., dated April 1, 1915; Kenneth V. Smith, dated April 19, 1915; Lieutenant Robert W. A. Salmond, M.D., to be Captain, dated May 1, 1915; Leonard H. Wootton, M.B., dated June 10, 1915; Serjeant Cyril Norton, from the Suffolk Yeomanry, to be Transport Officer with the honorary rank of Lieutenant, dated September 29, 1915.

3rd London General Hospital.—The undermentioned Lieutenants to be Captains, and to remain seconded: John St. A. Titmas, dated April 1, 1915; Harry A. Lucas, dated April 1, 1915; John B. Rawlins, dated May 30, 1915; Philip W. Green, dated August 5, 1915; Lieutenant Cecil R. Harrison, M.B., to be Captain, dated June 1, 1915.

4th London Field Ambulance.—The undermentioned Lieutenants to be Captains: Alfred M. Hughes, dated April 1, 1915; John M. Plews, dated April 1, 1915; Arthur E. Ironside, dated April 1, 1915; John A. Watt. M.B., dated April 10, 1915; Leslie P. Harris, dated July 14, 1915; George B. Pritchard, dated August 4, 1915; the date of appointment of Lieutenant William Morgan Langdon is August 2, 1915, and not as stated in the *London Gazette* of August 27, 1915.

4th London General Hospital.—The undermentioned Lieutenants to be Captains: John Everidge, F.R.C.S., dated April 1, 1915; Henry P. Ashe, dated April 1, 1915; George W. Shore, dated April 1, 1915; Charles E. H. Milner, dated April 22, 1915; David E. S. Davies, dated May 18, 1915; Arthur F. Comyn, M.B., dated May 26, 1915; Charles E. W. McDonald, dated June 12, 1915; William King Churchouse to be Lieutenant, dated September 28, 1915.

5th London Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Ernest G. Annis; William B. Hill, M.D.; Hector M. Calder, M.B.; John McMillan, M.B.

6th London Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: William Scarisbrick, M.B.; Thomas Murray; John F. W. Wyer; Frank Coleman; Henry B. F. Dixon, M.B.; Charles R. Woodruff; Wilfred R. Sadler.

The following announcement is substituted for that which appeared in the *London Gazette* of July 10, 1915: Lieutenant Philip S. Price to be Captain, dated April 1, 1915.

William H. Dickinson, dated July 26, 1915.

Captain Edward P. Minett, from the Territorial Reserve, to be Captain, dated August 16, 1915.

1st Highland Field Ambulance.—The undermentioned Captains to be temporary Majors, dated January 14, 1915: John D. Fiddes, M.B., F.R.C.S.Edin.; John H. Stephens, M.B.

3rd Highland Field Ambulance.—The following announcement is substituted for that which appeared in the *London Gazette* of August 4, 1915: Lieutenant Frederick C. Chandler, M.B., to be Captain, dated April 19, 1915.

4th Scottish General Hospital.—Captain Hugh Walker, M.B., from list of officers available on mobilization, to be Major on the permanent personnel, dated June 30, 1915.

Lowland Divisional Sanitary Section.—Lieutenant Thomas J. Mackie, M.B., to be Captain, dated April 1, 1915.

1st Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains: Ronald G. Badenoch, M.B., dated April 1, 1915; Francis Metcalfe, M.B., dated April 1, 1915; Roger Errington, M.B., dated April 15, 1915; Hubert Shield, M.B., dated May 1, 1915; John H. Barclay, M.B., dated May 18, 1915; Home A. P. Robertson, M.B., dated July 1, 1915; Kirton I. S. Smith, M.B., dated August 5, 1915.

2nd Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains: Alexander C. C. Lawrence, dated April 1, 1915; William M. Wilson, M.B., dated April 1, 1915; Valentine H. Wardle, dated April 15, 1915; William Smith, M.B., dated June 7, 1915; Thomas W. Crowley, M.D., dated June 15, 1915; William C. Stewart, M.B., F.R.C.S., dated June 22, 1915.

3rd Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: George H. Watson; Arthur C. M. Savege, M.B.

Northumbrian Divisional Sanitary Section.—Lieutenant Sydney J. Clegg, M.D., to be Captain, dated April 1, 1915.

Northumbrian Casualty Clearing Station.—Lieutenant Colin Mearns, M.B., to be Captain, dated April 1, 1915; Arthur Sutcliffe, M.B., dated May 11, 1915; Robert R. Lishman, M.B., dated May 14, 1915; Charles F. M. Saint, M.D., F.R.C.S., dated May 14, 1915; Richard W. Swayne, M.B., dated May 18, 1915.

1st Northern General Hospital.—Herbert Grantham Dodd, M.B., to be Lieutenant, dated August 16, 1915.

1st Southern General Hospital.—Harold Beckwith Whitehouse (late temporary Lieutenant, Royal Army Medical Corps), to be Captain, whose services will be available on mobilization, dated September 24, 1915.

Eastern Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Harold M. McC. Coombs, M.B., dated April 1, 1915; James MacB. Taylor, M.B., dated April 12, 1915; Basil Fawssett, dated May 11, 1915.

2nd Eastern General Hospital.—The following announcement is substituted for that which appeared in the *London Gazette* of September 30, 1914: Lieutenant Herbert John Walker, F.R.C.S.Edin., to be Captain on the permanent personnel, dated October 1, 1914.

South-Eastern Mounted Brigade Field Ambulance.—Lieutenant Edgar M. Jenkins, M.B., to be Captain, dated July 1, 1915.

1st Western General Hospital.—Captain Robert A. Bickersteth, M.B., F.R.C.S., to be Major, dated July 21, 1915.

2nd Western General Hospital.—The undermentioned Lieutenants to be Captains: Charles H. Crawshaw, M.B., dated May 9, 1915; Edward S. Brentnall, M.B., dated May 9, 1915; Thomas P. Kilner, M.B., dated August 24, 1915; Private Stanley Henry Heighway to be Quartermaster, with the honorary rank of Lieutenant.

3rd Western General Hospital.—Lieutenant Ivor J. Davies, M.D., to be Captain, dated April 1, 1915.

1st South-Western Mounted Brigade Field Ambulance.—Lieutenant William C. Hodges to be Captain, dated April 1, 1915; Lieutenant Leighton H. Hay, M.B., to be Captain, dated April 3, 1915; Captain Charles W. Edwards, F.R.C.S., to be temporary Major, dated July 5, 1915.

2nd South-Western Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Philip S. Martin, dated April 1, 1915; Joseph Grant-Johnston, dated June 24, 1915.

1st East Anglian Field Ambulance.—Lieutenant Robert Ellis, M.B., to be Captain, dated April 1, 1915.

2nd East Anglian Field Ambulance.—The following announcement is substituted for that which appeared in the *London Gazette* of July 1, 1915: Lieutenant James Arthur, M.D., to be Captain, dated April 1, 1915; Lieutenant Archibald B. Pettigrew to be Captain, dated June 14, 1915; Lieutenant Arthur W. Hayward to be Captain, dated July 1, 1915.

3rd East Anglian Field Ambulance.—Lieutenant Alexander Cuffe, M.D., F.R.C.S., to be Captain, dated August 19, 1915; Lieutenant Edward K. Goodwin to be Captain, dated August 27, 1915.

1st South Midland Mounted Brigade Field Ambulance.—Lieutenant Alexander Leggat, M.B., to be Captain, dated April 1, 1915; Lieutenant Donald Buchanan to be Captain, dated September 25, 1915.

2nd South Midland Mounted Brigade Field Ambulance.—Lieutenant-Colonel Arthur Gervase Hendley, retired list, Indian Medical Service, to be Captain (temporary), dated August 11, 1915.

2nd South Midland Field Ambulance.—William James Forsyth Craig to be Lieutenant, dated August 27, 1915; Major Francis J. Warwick, M.B., from East Anglian Casualty Clearing Station, to be Major, dated September 25, 1915; Captain Donald Buchanan, from 1st South Midland Mounted Brigade Field Ambulance, to be Captain, dated September 25, 1915.

North Midland Mounted Brigade Field Ambulance.—James Mitchell, M.B., to be Lieutenant, dated September 14, 1915; Major Arthur G. Goodwin, M.B., F.R.C.S., to be temporary Lieutenant-Colonel, dated September 24, 1915; Captain Thomas George Buchanan, M.B., to be temporary Major, dated September 24, 1915.

North Midland Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Montague Dixon, M.D., dated April 16, 1915; Lieutenant William T. Wood to be Captain, dated April 19, 1915; David D. McNeill, dated April 21, 1915; Vincent A. P. Costobadie, F.R.C.S.Edin., dated April 22, 1915; George W. M. Andrew, dated April 22, 1915; James H. Thomas, M.B., dated April 24, 1915.

1st North Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: John C. Grieve, M.B., dated April 1, 1915; Ronald B. Berry, M.B., dated April 19, 1915; Francis G. Bennett, dated April 20, 1915; Charles B. Johnstone, M.B., dated May 18, 1915.

2nd North Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: Lionel T. Challenor, dated April 1, 1915; Robert B. M. Yates, M.B., dated April 1, 1915; Bertram S. Wills, F.R.C.S., dated April 24, 1915; Thomas Graham, M.B., dated April 26, 1915; Samuel R. Foster, M.B., dated May 27, 1915; Major John E. O'Connor, M.B., from the Sanitary Service, to be Major, dated September 17, 1915.

3rd North Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: William Boyd, M.D., F.R.C.S.Edin., dated April 1, 1915; Joseph C. Harris, dated April 1, 1915; Guy F. Haycraft, dated April 1, 1915; Stanley S. B. Harrison, dated April 17, 1915; William B. Williams, M.B., dated July 23, 1915.

Notts and Derby Mounted Brigade, Field Ambulance.—The date of appointment as Lieutenant of David William Griffiths is July 22, 1915, and not as stated in the *London Gazette* of August 23, 1915.

1st East Lancashire Field Ambulance.—Captain John Bruce, M.B., to be temporary Major, dated February 15, 1915; Lieutenant Stanley Hodgson, M.D., to be Captain, dated April 10, 1915; Lieutenant Henry E. Fox, M.B., to be Captain, dated April 30, 1915.

2nd East Lancashire Field Ambulance.—Lieutenant George R. Hitchin, M.B., to be Captain, dated May 22, 1915.

3rd East Lancashire Field Ambulance.—Lieutenant Wilfred E. Rothwell, M.B., to be Captain, dated May 18, 1915; Lieutenant Gerald G. Wray, M.B., to be Captain, dated May 9, 1915.

West Lancashire Casualty Clearing Station.—The following announcement to be substituted for that which appeared in the *London Gazette* of July 10, 1915, Lieutenant William N. W. West-Watson, M.D., to be Captain, dated April 1, 1915.

1st West Lancashire Field Ambulance.—John St. George Wilson to be Lieutenant, dated July 24, 1915.

2nd West Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: William R. Pierce, M.D., dated April 1, 1915; John F. Roberts, M.B., dated April 1, 1915; James H. Rawlinson, M.B., dated April 1, 1915; George C. King, dated May 30, 1915; Herbert E. Marsden, M.B., dated July 1, 1915.

3rd West Lancashire Field Ambulance.—Captain Ernest Knight, M.B., to be temporary Major, dated August 14, 1915. The undermentioned Lieutenants to be Captains: Frank Hauxwell, M.B., dated April 1, 1915; Robert D. B. Frew, M.D., dated April 1, 1915; Harry Middleton, M.B., dated April 1, 1915; Adam A. Turner, M.B., dated April 1, 1915; Gilbert W. Rogers, dated June 15, 1915; Walter R. Stephen, M.B., dated August 1, 1915.

South Wales Mounted Brigade Field Ambulance.—Norman Theodore Kingsley Jordan, M.B., to be Lieutenant, dated August 6, 1915.

Welsh Border Mounted Brigade Field Ambulance.—Gerald Douglas Newton to be Lieutenant, dated August 15, 1915.

Welsh Casualty Clearing Station.—Captain Evan J. T. Cory, M.D., from Attached to Units other than Medical Units, to be Captain, dated July 11, 1915; Captain Evan J. T. Cory, M.D., to be temporary Major, dated July 11, 1915.

1st Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: Donald Macaulay, M.B., dated April 1, 1915; Edward B. H. Hughes, dated June 16, 1915; Henry Mills, dated July 26, 1915; Alexander E. Mackenzie, dated July 27, 1915; John S. Tomb, M.B., dated August 1, 1915; O'Connell Sullivan, M.B., to be Lieutenant, dated August 30, 1915.

2nd Welsh Field Ambulance.—Lieutenant John P. H. Davies to be Captain, dated June 18, 1915.

3rd Welsh Field Ambulance.—Lieutenant Richard J. Isaac to be Captain, dated May 4, 1915; Lieutenant Joseph Carroll, M.B., to be Captain, dated May 13, 1915.

Yorkshire Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: John Downie, M.B.; Edward D. Ellis.

1st West Riding Field Ambulance.—The undermentioned Lieutenants to be Captains: Basil Hughes, M.B., F.R.C.S., dated April 1, 1915; Harry Lee, dated April 1, 1915; John C. Metcalfe, M.B., dated April 13, 1915; Frank Wigglesworth, M.B., dated April 30, 1915; John H. Blackburn, M.B., dated May 12, 1915; Lawrence A. Mackenzie, M.B., dated May 17, 1915; John Pinder, dated May 14, 1915; Hugh R. Partridge, dated May 23, 1915; Henry W. Robinson, M.B., dated June 22, 1915.

The following announcement is substituted for that which appeared in the *London Gazette* of August 6, 1915:

Captain Harry W. Shadwell, from Attached to Units other than Medical Units, to be Captain, dated August 7, 1915.

2nd West Riding Field Ambulance.—The undermentioned Lieutenants to be Captains: Samuel S. Greaves, dated April 1, 1915; Francis W. Begg, M.B., dated April 5, 1915; Charles N. Smith, M.B., dated April 7, 1915; Hartas Foxton, M.B., dated July 1, 1915; William H. Smailes, M.D., dated June 28, 1915; Benjamin Holroyd, dated July 19, 1915.

3rd West Riding Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: William B. Allen, M.B.; Robert A. Stark, M.B.; John P. Mathews, M.B.; Donald S. Twigg; William W. J. Lawson, M.B., dated April 30, 1915; William T. D. Mart, dated June 11, 1915; Ernest White, dated July 28, 1915.

1st Wessex Field Ambulance.—The undermentioned Lieutenants to be Captains: Charles H. Maskew, M.B., dated April 1, 1915; Robert Burgess, dated April 1, 1915; Edmond L. Meynell, M.B., dated April 16, 1915; Fred Ellis, dated April 24, 1915; Claude J. E. Bennett, dated April 26, 1915; John A. Bell, M.B., dated April 26, 1915.

2nd Wessex Field Ambulance.—Lieutenant Henry W. Spaight to be Captain, dated April 1, 1915; Arthur C. Hincks, M.B., dated April 1, 1915; Thomas D. Bell, dated April 6, 1915; Angus Cameron, M.B., dated April 12, 1915; William T. P. Meade-King, dated April 13, 1915; George L. K. Pringle, M.D., dated April 19, 1915; Tom R. Kenworthy, dated April 25, 1915; John P. Milton, dated April 26, 1915; William H. H. Bennett, M.B., dated April 30, 1915; William Robertson, M.B., dated May 2, 1915; Henry N. Collier, dated May 20, 1915; Charles F. Backhouse, dated May 22, 1915; Quartermaster-Serjeant William Pickard to be Transport Officer, with the honorary rank of Lieutenant.

3rd Wessex Field Ambulance.—The undermentioned Lieutenants to be Captains: Arthur H. Davis, M.B., dated April 26, 1915; Frederick Tooth, dated April 26, 1915; Frederick W. Brunker, dated April 28, 1915; Philip McRitchie, dated April 28, 1915; Frank L. Dickson, M.B., dated April 28, 1915; Frederick B. Stewart, M.B., dated April 29, 1915.

1st Home Counties Field Ambulance.—The undermentioned Lieutenants to be Captains: Robert R. J. Holmes, dated April 1, 1915; William B. Keith, M.D., dated April 1, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of July 15, 1915: The undermentioned Lieutenants to be Captains: Duncan M. Johnston, M.B.; Charles W. Greene, M.B., F.R.C.S., dated April 1, 1915; Arthur Maude, dated May 7, 1915; Hugh S. Palmer, M.B., dated May 10, 1915; James E. Turle to be Captain, dated May 14, 1915; Charles H. Gregory, M.D., dated May 14, 1915; Major Joseph Ward to be temporary Lieutenant-Colonel, dated June 5, 1915; John S. Ward, dated June 12, 1915; Lieutenant Richard A. Freeman to be Captain, dated August 10, 1915.

2nd Home Counties Field Ambulance.—The undermentioned Lieutenants to be Captains: Arthur C. Watkin, dated April 29, 1915; James W. Cairns, M.D., dated May 4, 1915; Frank Scroggie, M.B., dated May 15, 1915; George M. McGillivray, dated May 30, 1915.

3rd Home Counties Field Ambulance.—The undermentioned Lieutenants to be Captains; Alexander H. Brewer, dated April 1, 1915; Frederic E. H. Keogh, dated April 1, 1915. The following announcement is substituted for that which appeared in

the *London Gazette* of July 23, 1915: Lieutenant Alfred E. L. Devonald to be Captain, dated April 1, 1915; Charles E. M. Hey, dated June 8, 1915; Henry W. Wier, dated June 10, 1915; Edgar W. Matthews, M.B., dated June 12, 1915; Henry J. Brownrigg, M.D., dated June 21, 1915; Philip T. Jones, dated June 29, 1915.

TERRITORIAL FORCE RESERVE.

Royal Army Medical Corps.

Colonel Stanley S. Hoyland, M.D., from Assistant Director of Medical Services, East Anglian Division, to be Colonel.

The following announcement is substituted for that which appeared in the *London Gazette* of September 18, 1915:—

Captain William Boyd, M.D., F.R.C.S.Edin., from the 3rd North Midland Field Ambulance, to be Captain, dated September 19, 1915.

Lieutenant William Boyd, M.D., F.R.C.S., from 3rd North Midland Field Ambulance, to be Lieutenant.

Lieutenant Arthur L. Bastable, M.B., from 2nd Northumbrian Field Ambulance, to be Lieutenant, dated August 24, 1915.

Territorial Force Nursing Service.

Miss Florence Tomlin to be Matron, 2nd Northern General Hospital, dated April 21, 1915.

Miss Eliza M. Vezey, to be Matron, 5th London General Hospital, dated August 16, 1915.

Attached to Units other than Medical Units.

The undermentioned Lieutenants to be Captains:—
George H. H. Manfield, dated April 1, 1915.
Sidney Scott, M.B., dated April 1, 1915.
James A. Stenhouse, M.B., dated April 1, 1915.
James A. C. Scott, M.B., dated April 1, 1915.
James Anderson, M.B., dated April 1, 1915.
John E. Brydon, M.B., dated April 1, 1915.
John L. Green, dated April 1, 1915.
Maurice H. Barton, dated April 1, 1915.
George A. Brogden, M.D., dated April 1, 1915.
William Dale, dated April 1, 1915.
Joseph W. Scott, dated April 1, 1915.
Frank R. Armitage, M.B., dated April 1, 1915.
Stanley Southam, dated April 1, 1915.
James H. Crane, M.D., dated April 1, 1915.
Archibald C. Haddow, M.B., dated April 1, 1915.
John G. Cooke, M.B., dated April 1, 1915.
William E. Falconar, M.B., dated April 1, 1915.
Edward J. Blair, M.B., dated April 1, 1915.
Harry W. Shadwell, dated April 1, 1915.
Josiah Walker, M.B., dated April 1, 1915.
Archibald Hamilton, M.B., dated April 2, 1915.
James P. N. Casey, dated April 9, 1915.
Robert E. T. Tatlow, M.D., dated April 10, 1915.
Alfred E. Delgado, M.B., dated April 16, 1915.
Harold D. Lane, dated April 19, 1915.
Frank H. C. Watson, M.B., dated April 24, 1915.
Harry M. Soden, dated May 5, 1915.
John S. Clarke, M.B., dated May 9, 1915.
John J. Porter, dated May 16, 1915.
John C. Marklove, dated May 20, 1915.
Eliezer Coplans, dated May 21, 1915.
William L. R. Wood, dated May 27, 1915.
David A. R. Haddon, M.B., dated May 29, 1915.
Gerald F. Carr, dated June 11, 1915.
Henry C. C. Hackney, dated June 17, 1915.

Thomas R. W. Atkins, dated June 26, 1915.
John S. Hall, M.B., dated August 1, 1915.
Hugh B. Cunningham, M.B., dated August 12, 1915.
Temporary Major Antony A. Martin, M.D., from 2nd Home Counties Field Ambulance, to be Major (temporary), dated September 12, 1915.
Lieutenant William M. Cox. from South Midland Casualty Clearing Station, to be Lieutenant, dated September 28, 1915.
The undermentioned Lieutenants to be Captains:—
Edward Bromet, dated April 1, 1915.
William Rogers, M.D., dated April 1, 1915.
Godfrey K. Maurice, dated April 1, 1915.
William T. Briscoe, dated April 1, 1915.
Andrew Baxter, M.D , dated April 1, 1915.
Morrice Greer, dated April 1, 1915.
William Scott, M.B., dated April 1, 1915.
Cresswell Burrows, M.D., dated April 1, 1915.
Maurice U. Wilson, dated April 1, 1915.
Humphry J. Wheeler, M.D., dated April 1, 1915.
John Wotherspoon, M.B., dated April 1, 1915.
George F. White, M.D., dated April 1, 1915.
Hyman Lightstone, dated April 1, 1915.
John J. Scanlan, dated April 1, 1915.
Alfred H. Bell, dated April 1, 1915.
Frank H. White, dated April 1, 1915.
Hugh H Robinson, dated April 1, 1915.
Thomas W. S. Hills, dated April 1, 1915.
Eric L. Giblin, M.B., dated April 1, 1915.
Percy W. Kent, dated April 1, 1915.
Edgar Babst, M.B., dated April 1, 1915.
Arthur L. M. Churchill, dated June 17, 1915.
Leslie M. Ladell, M.B., dated May 27, 1915.
Daniel D. Brown, M.D., dated April 19, 1915.
James H. Chauncy, dated June 21, 1915.
George MacL. Levack, M.B., dated April 19, 1915.
Herbert Edward Murray, M.B., dated April 20, 1915.
Lionel G. Pearson, M.B., dated April 28, 1915.
Harry G. Butterfield, M.D., dated May 4, 1915.
Arthur S. Walker, M.D., dated May 13, 1915.
Herbert Robertson, M.B., dated May 15, 1915.
Thomas L. de Courcy, M.D., dated May 17, 1915.
George Eustace, M.D., dated May 18, 1915.
John H. Jordan, dated June 9, 1915.
Joseph P. Fagan, dated June 11, 1915.
Thomas Aspinall to be Lieutenant, dated July 12, 1915.
Frederick G. Vicars, dated July 15, 1915.
Alexander F. Wilson, M.B., dated July 21, 1915.
Kenneth J. T. Keer, dated July 23, 1915.
Ivan W. McKimmon, M.D., dated July 20, 1915.
Meredith Broderick Dawson to be Lieutenant, dated September 18, 1915.
Captain David A. Hughes to be Major, dated July 18, 1915.
Captain George F. Morley to resign his commission on account of ill-health.
Lieutenant William J. Lacy-Hickey, M.B., to be Captain, dated August 19, 1915.
Andrew MacLennan, M.B. (late Surgeon-Captain, 2nd Volunteer Battalion, the Cheshire Regiment), to be Captain, dated August 20, 1915.
Captain Harold B. Porteous, M.B., from 2nd South Western Mounted Brigade, Field Ambulance, to be Captain.

SANITARY SERVICE.

Major Charles E. Humphreys to be Lieutenant-Colonel, dated August 8, 1915.
The undermentioned Officers relinquish their commissions, dated September 10, 1915:—
Lieutenant-Colonel Robert S. Gibb, M.B.
Lieutenant-Colonel William G. Stevens.
Major William Bruce, M.D.

Major John C. McVaill, M.D.
Captain Henry W. Beach.
Captain James A. Cameron, M.D.
Captain David Havard.
Captain George F. McCleary, M.D.
Captain Thomas Rogerson, M.B.
Major George Reid, M.D., resigns his commission on account of ill-health, dated September 14, 1915.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1915.

Title of Work and Author	Edition	Date	How obtained
Gunshot Injuries, how they are inflicted, their Complications and Treatment. By Colonel Louis A. Lagarde, Medical Corps, U.S.A.		1915	Library Grant.
The Minor Horrors of War. By A. E. Shipley ..	2nd	1915	,, ,,
Sanitation in War. By Major P. S. Lelean, R.A.M.C.		1915	,, ,,
War Surgery. By E. Delorme. Translated by H. de Meric		1915	,, ,,
Radiography, X-Ray Therapeutics, and Radium Therapy. By Robert Knox, M.D.		1915	,, ,,
The Diagnostics and Treatment of Tropical Diseases. By E. R. Stitt, M.D.		1915	,, ,,
Cambridge Public Health Series: Sewage Purifica tion and Disposal. By G. B. Kershaw		1915	,, ,,
Gas Poisoning in Mining and other Industries. By John Glaister, M.D., and D. L. Logan, M.D		1914	,, ,,
The British Pharmaceutical Codex and Suppplement		1911-15	,, ,,
The Medical Annual		1915	,, ,,
Theoretical Chemistry. By W. Nernst. Revised by H. T. Tizard		1911	,, ,,
Organic Chemistry. 2 vols. By Prof. V. von Richter. Edited by Prof. R. Anschütz. Translated by E. F. Smith		1912	,, ,,
Dairy Chemistry. By H. D. Richmond	2nd	1914	,, ,,
Treatise on General and Industrial Chemistry. By E. Molinari. English Translation. 2 vols.		1912-13	,, ,,
The Treatment of Fractures. By C. L. Scudder, M.D.	8th	1915	,, ,,
Collected Papers of the Mayo Clinic. Edited by Mrs. M. H. Mellish. Vol. vi. 1914		1915	,, ,,
A Text-Book of Physiological Chemistry. By Olof Hammarsten and S. G. Hedin. Translated by John A. Mandel	7th	1914	,, ,,
A Text-Book of Pharmacology and Therapeutics. By Arthur R. Cushny, M.D., F.R.S.	6th	1915	,, ,,
Treatment of Diseases of the Eye. By Dr. V. Hanke. Translated by J. H. Parsons and G. Coats		1905	,, ,,
Surgery of Deformities of the Face. By J. B. Roberts		1912	,, ,,
Surgery and Diseases of the Mouth and Jaws. By V. P. Blair, A.M., M.D.	2nd	1913	,, ,,

List of Books added to the Library—*Continued.*

Title of Work and Author	Edition	Date	How obtained
John Shaw Billings: a Memoir. By Fielding H. Garrison, M.D.		1915	Library Grant.
Tenth and Eleventh Reports of the Henry Phipps Institute for the Study, Treatment, etc., of Tuberculosis		1915	Editor, Journal.
Report on Higher Education in the State of New York for the School Year ending July 31, 1913		1915	,, ,,
Elements of Surgical Diagnosis. By Sir A. Pearce Gould. Revised by E. Pearce Gould	4th	1914	,, ,,
A Text-Book of Radiology. By E. R. Morton, M.D.		1915	,, ,,
Dietetics, or Food in Health and Disease. By W. Tibbles, M.D.		1914	,, ,,
The Acute Abdomen. By W. H. Battle	2nd	1914	,, ,,
Annual Report of the Surgeon-General of the Public Health Service of the United States for the Fiscal Year 1914		1914	,, ,,
The Medical Annual Synoptical Index to Remedies and Diseases. For the ten years 1905 to 1914		1915	,, ,,
Index Catalogue of the Library of the Surgeon-General's Office, United States Army. Second Series. Vol. xix		1914	Surgeon-General, U.S. Army.
Annual Report of the Sanitary Commissioner with the Government of India for 1913			Secretary of State for India in Council.
Proceedings of the National Academy of Sciences. Vol. i. Numbers 1 to 8.		1915	Commandant's Office.
Metropolitan Water Board: Eleventh Report on Research Work. By Dr. A. C. Houston.		1915	Presented by Dr. A. C. Houston.
Report of the Eighty-fourth Meeting of the British Association for the Advancement of Science. Australia, 1914; July 28 to August 31.			Presented by Surgeon-General Sir D. Bruce, C.B., F.R.S.
The Journal of Pathology and Bacteriology. Vol. xx. No. 1. July, 1915		1915	,, ,,
Military Report on the Straits Settlements, 1915 ..		1915	War Office.

DEATH.

MANDERS.—On August 9, 1915, killed in action at the Dardanelles, Colonel Neville Manders, Army Medical Service, aged 55, youngest son of the late Major Thomas Manders, 6th Dragoon Guards (Carabiniers), and the late Mrs. Manders, of Marlborough, Wilts, dear husband of Maude Braybrooke, only child of F. W. Vane (of Ceylon), Glenthorne, Bexhill-on-Sea. "In Arduis Fidelis."

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The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

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	8	0 9 0	0 4 4	6 6	3 3	5 6	2 0
	16	0 16 9	0 6 9				
200	4	0 8 6	0 4 0				
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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Colonel R. J. Reece, Lieutenant-Colonel P. H. Falkner, Major W. S. Carline, Major G. Baillie, Major M. Sinclair, Captain C. M. Page, Lieutenant J. S. Goodacre, Lieutenant J. Anderson, Lieutenant L. H. C. Birkbeck, Lieutenant G. N. Lorimer, Serjeant-Major E. B. Dewberry, C. Hamilton Whiteford, Lieutenant A. J. Trinca.

The following publications have been received:—

British: *The Indian Medical Journal, The Lancet, The Sanitary Record and Municipal Engineering, The Journal of Tropical Medicine and Hygiene, The Medical Press and Circular, The Indian Medical Gazette, The Indian Journal of Medical Research, Guy's Hospital Gazette, Tropical Diseases Bulletin, The Hospital, The Journal of State Medicine, The Practitioner, St. Bartholomew's Hospital Gazette, Bulletin of Entomological Research.*

Foreign: *Revista de Sanidad Militar, Bulletin de l'Institut Pasteur, Le Caducée, The Military Surgeon, Office International d'Hygiene Publique, Russian Naval Medical Journal.*

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

AUGUST, SEPTEMBER, AND OCTOBER, 1915.

THE King has been graciously pleased to give orders for the appointment of Colonel Michael Thomas Yarr, F.R.C.S.I., to be a Companion of the Order of the Bath, for distinguished service in the Field, dated October 15, 1915. *London Gazette*, October 15, 1915.

War Office,
October 2, 1915.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned officer, in recognition of his gallantry and devotion to duty in the Field:—

CAPTAIN ERNEST COTTON DEANE, ROYAL ARMY MEDICAL CORPS (ATTACHED 2ND BATTALION, THE LEICESTERSHIRE REGIMENT).

For conspicuous gallantry on August 22, 1915, near Fauquissart. A standing patrol 120 yards in front of our line was bombed by the enemy at about 10 p.m., the only notification being two loud explosions. Captain Deane, without any knowledge of the enemy's strength, at once got over the parapet and ran by himself to the spot under rifle and machine gun fire. Finding four wounded men he returned for stretchers and got them back into safety.

This is not the first time that Captain Deane's gallantry under fire has been brought to notice. *London Gazette*, October 2, 1915.

ARMY MEDICAL SERVICE.

Colonel Herbert J. Barratt, on completion of four years' service in his rank, is retained on the active list, under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be supernumerary, dated October 2, 1915.

ROYAL ARMY MEDICAL CORPS.

The undermentioned to be temporary Lieutenant-Colonels:—

Dated September 4, 1915.—William Perceval Gore Graham.

Dated September 13, 1915.—Frank Romer; Herbert Lightfoot Eason, M.D.

The undermentioned to be granted temporary rank whilst employed with the Huddersfield War Hospital:—

As Lieutenant-Colonel:—

Dated September 1, 1915.—William Lawrence Wright Marshall.

Lieutenant-Colonel Henry J. Fletcher is retained on the active list under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be supernumerary, dated October 7, 1915.

Captain Victor P. Hutchinson is placed on retired pay on account of ill-health, dated October 8, 1915.

The name of temporary Captain Henry G. Peake, M.B., is as now described, and not as stated in the *Gazette* of September 6, 1915.

The name of temporary Lieutenant Robert John Kee, M.B., is as now described, and not as stated in the *Gazette* of August 17, 1915.

The undermentioned to be temporary Majors:—

Dated September 1, 1915.—Ernest George Coward, M.B.

Dated September 9, 1915.—Henry Maurice Chasseaud, M.D.

Dated September 10, 1915.—Thomas Basil Rhodes, M.B., whilst employed with the North Staffordshire Infirmary.

Dated September 15, 1915.—William Richard Dawson, M.D.; Francis Carmichael Purser, M.D.

Dated September 22, 1915.—Temporary Captain Donald K. McDowell, C.M.G., whilst in charge of the Tooting Military Hospital.

Dated September 29, 1915.—Temporary Captain Albert T. Duka, D.S.O.

The name of temporary Captain Henry G. Wiltshire is as now described, and not as stated in the *Gazette* of September 6, 1915.

The appointment to a temporary Captaincy of Percival Wood is antedated to March 27, 1915.

The appointment to a temporary Lieutenancy of Valentine Frederick Stock, M.B., is antedated to July 2, 1915.

The undermentioned to be temporary Captains:—

Temporary Lieutenant William J. Maloney, M.D., F.R.C.S.Edin., dated September 6, 1915.

George Alexander Finlayson, M.B., late Captain Singapore Volunteer Corps, dated September 13, 1915.

Edmund Francis Neville Currey, dated September 14, 1915.

Temporary Lieutenant Robert M. Forde, dated September 18, 1915.

The names of the undermentioned temporary Captains are as now described, and not as stated in the *Gazette* of September 6, 1915:—

Thomas E. Parker, M.B.

Bernard H. Wedd, M.D.

Lieutenant Clark McKerrow, M.D., from Reserve of Officers, to be temporary Lieutenant, dated June 24, 1915 (substituted for the notification which appeared in the *Gazette* of July 13, 1915).

The appointment to a temporary Lieutenancy of Ross Millar, M.D., is antedated to July 20, 1915.

Lieutenant Andrew Topping, M.B., from the Gordon Highlanders, to be temporary Lieutenant, dated August 22, 1914 (substituted for the notification which appeared in *Gazette* of September 1, 1914).

The name of temporary Lieutenant Samuel Gurney-Dixon is as now described, and not as stated in the *Gazette* of September 29, 1914.

The appointment to a temporary Lieutenancy of William R. Mackenzie is antedated to October 3, 1914.

James Elrick Adler, F.R.C.S., to be temporary Honorary Captain whilst serving with No. 7 British Red Cross (Allied Forces Base) Hospital, dated October 7, 1915.

The name of temporary Quartermaster and Honorary Lieutenant Donald Hector McDonald is as now described, and not as stated in the *Gazette* of September 22, 1915.

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated August 18, 1915.—Sidney Smith, M.B.

Dated September 1, 1915.—John P. Charles, M.B.; John Higgins; William W. Ingram, M.B.; Edmund B. Jardine; David A. Laird, M.B.; Henry A. Ronn, M.B.; John G. Priestley, M.B.; Aubrey W. Venables; Gerald Whittington, M.B.; George T. Whyte, F.R.C.S.I.

Dated September 2, 1915.—John G. Brown, M.B.; Edward R. C. Cooke; Percy Northcote, M.B.

Dated September 4, 1915.—Stanley G. Luker, M.D.; James H. Fletcher.

Dated September 7, 1915.—James C. Dick, M.B.

Dated September 8, 1915.—Alexander Manuel, M.B.

Dated September 9, 1915.—Evan H. Jones, M.B.; Cyril D. Faulkner; Charles L. Herklots; Geoffrey D. Harding, M.B.; Douglas M. Hunter, M.B.; John M. Mitchell, M.B.; John Mowat, M.B.; John M. Moyes, M.B.; Aneurin E. Roberts, M.B.; Francis C. Robbs; Thomas H. Ravenhill, M.B.

Dated September 10, 1915.—John A. Andrews, M.B.; John S. Arkle, M.B.; Hugh J. Couchman, M.B.; Edward Gordon, M.B.; Bernard G. Gutteridge; Frank W.

Harlow, M.B.; George B. Holroyde; Reginald S. A. Heathcote, M.B.; Gavin L. McLean, M.B.; Donald MacIntyre, M.B.; Louis A. Moran; Samuel E. McClatchey, M.B.; Matthew W. B. Oliver, M.B., F.R.C.S.; Henry W. Parnis, M.D.; Gavin Stiell; Richard H. Stevens; Edward Seelly, M.B.; Frederick E. Tillyard, M.B.; Hill W. White, M.B.; Gerald D. H. Wallace; Robert E. Cree, M.D.

Dated September 11, 1915.—Reginald G. Abrahams, M.B.; Robert M. Allan, M.B.; James H. Barry; Alexander E. Chisholm, M.B., F.R.C.S.Edin.; Claude N. Coad, M.B.; George D. Eccles; John H. G. Hunter, M.B.; Alexander W. Hendry, M.B.; Richard A. Jones; John R. Marsack, M.B.; Benjamin B. Noble, M.B.; Thomas Bourne-Price; Robert E. Roberts, M.B.; Robert C. Robertson, M.B.; Philip Smith; Wilfred A. Sneath, M.B., F.R.C.S.; Walter B. Bannerman; William E. M. Armstrong, M.D.

Dated September 12, 1915.—William Lumley; Daniel J. Thomas, M.D.; William Kennedy-Taylor.

Dated September 14, 1915.—Henry R. Knowles, M.B.; Thomas L. Ingram; Walter H. Swaffield, M.D., F.R.C.S.Edin.; Gwilym James.

Dated September 15, 1915.—Ernest C. Lindsay, M.B., F.R.C.S.; George E. Neligan, M.B., F.R.C.S.; Herbert A. Lake; Samuel C. R. Flaxman; Allan C. Hancock; Wilfred Stephen Fox, M.D.

Dated September 16, 1915.—John McI. Morgan; James McTurk; James Kirker; John S. Lloyd, M.B.; William N. Kingsbury; George W. Lloyd, M.B.; Herbert J. Rawson; Claude H. B. Booth; James D. G. Stewart, M.B.; Edgar F. Edmunds, M.B.; Harold G. Janion; Russell F. Wilkinson; Eustace C. Black, M.B.; William Griffith, M.B.; Charles St. A. Vivian; Noel Dean Bardswell, M.D.

Dated September 17, 1915.—Richard F. Bolt; Daniel S. Cooper, M.B.; Cecil M. Jones, M.B.; Richard B. Johnson; Alfred C. Jepson; William H. Parry, M.B.; Hugh Pierce, M.D.; Henry C. D. Miller, M.B.

Dated September 18, 1915.—Henry A. Lunn.

Dated September 19, 1915.—George V. Bakewell, M.B.; Frederick F. Middleweek; Valentine C. Martyn; David Y. Buchanan, M.B.; Emanuel P. Scott; Edward L. Puddicombe; Murdoch M. Rodger, M.D.; Henry C. Woodyatt; William Ainslie, M.D., F.R.C.S.Edin.

Dated September 20, 1915.—Gideon Walker, M.B.; John F. Smith, M.B.; William Moodie, M.D.; Thomas H. Body; Charles Edgar Lea, M.D.; John Glanville Milne, M.B.; Robert Henry Strong, M.B.; John Whigham, M.B.

Dated September 21, 1915.—Octavius de B. Marsh, M.B.; Andrew Currie, M.B.; Robert Hannah, M.B.; Stanley Ritson, F.R.C.S.; Alexander Lindsay, M.B.; Alexander L. Aymer, M.B.

Dated September 22, 1915.—Rudolph G. Abercrombie, M.D.; Cornelius A. O'Driscoll; John S. Williamson; Herman W. Webb, M.B., F.R.C.S.Edin.; Sydney H. Hay, M.B.; Robert Marshall, M.B.; Arthur A. Straton, M.D., F.R.C.S.Edin.; William H. R. McCarter, M.B.; Charles R. Smith; Samuel Gurney-Dixon; Alexander J. Will, M.B.; Basil N. Murphy; Alan G. Bodman; George F. Hardy; Hugh F. Warwick, M.B.; William W. Waller, M.B.; Alexander M. Ross; The Honorable Lennox H. Lindley, M.B.; Lionel T. Wells.

Dated September 23, 1915.—Bartholomew J. Hackett, M.B.; Christopher C. Court, M.B.; Elston H. Lawson, M.D.; Frank Dallimore, M.B.

Dated September 24, 1915.—Elliott T. Glenny, M.B.; James L. Wilson, M.B.

Dated September 25, 1915.—Daniel T. H. Croly.

Dated September 26, 1915.—Charles E. Redman; Kenneth C. Middlemiss, M.B.; Charles L. Spackman, M.B.; Robert W. L. Todd, M.B.; Morton Peto, M.B.; William Brown, M.B.; Allan N. Minns; Alexander Bremner, M.B.

Dated September 28, 1915.—John I. Johnson; Alexander C. Palmer, M.B., F.R.C.S.; Alan H. Birks; James L. R. Philip, M.B.

Dated September 30, 1915.—Frederick B. Dreyer, M.B.; Lindsay C. Smith; Arthur B. Appleton; Francis C. Macdonald, M.B.; George L. Grant.

Dated October 5, 1915.—Adolphe Abrahams, M.D.; Oliver Eaton.

Dated October 6, 1915.—Arthur G. Welsford, M.D., F.R.C.S., late Captain, The Hertfordshire Regiment, to be temporary Captain.

The undermentioned Lieutenants (on probation) are confirmed in their rank: William Bryars; George Chesney; Samuel Browne; John S. Armstrong, M.B.; Oswald D. Jarvis, M.B.; Rudolph A. Peters, M.B.

The undermentioned to be temporary Lieutenants:—

Dated July 24, 1915.—Robert Orr Whyte, M.B.; Hugh Walter Pigeon, M.D.

Dated July 27, 1915.—Jacob Rosenthal, M.B.

Dated August 4, 1915.—John Robert Lee, M.D., F.R.C.S.Edin.

Dated August 12, 1915.—Graham Colville Ramsay, M.B., from the Indian Medical Service.

Dated August 23, 1915.—William Alfred Costain.

Dated August 26, 1915.—Roderick MacLean; Amos Hubert Coleman, M.B.

Dated August 30, 1915.—William Egon Halinan Beard, M.B.; Matthew Thornton Cassidy, M.B.

Dated September 1, 1915.—Thomas Joseph Buckley, M.B.; Patrick Thomas Tullock Macdonald, M.B.; John George Crouyn; Thomas Davidson Miller, M.B.; John Campbell Boyd, M.D.; John McKie, M.B.; Elliott John Storer; George Cooper, M.D.; William Alexander Stuart, M.B.; Louis Charles Martin; Malcolm Sommerville, M.B.; John Sawers Findley, M.B.; Alexander Scott, M.B.; Percy Collins Litchfield; Ralph Vincent Howell, M.B.; John Watson, M.B.; Ralph Annesley Fuller; James Philip; Edwin George Bleakley Calvert, M.B.; Herbert James Foote, M.B.; James Wyper, M.B.; Peter Sturrock; Christopher Hugh Leete Rixon; John Edgar Taylor; Henry James Thomson, M.B.; William John Shields.

Dated September 2, 1915.—Henry Claude Carter; Lancelot Eric Charles Peckover.

Dated September 3, 1915.—John Lawrence Graham-Jones, M.B.

Dated September 4, 1915.—Henry Pratt Newsholme, M.D.; John Mallock, M.B.; Harold Sugden Vivian, M.B.; John Kerr Morton, M.B.; William Alexander Twigg.

Dated September 5, 1915.—Hugh McLen.

Dated September 6, 1915.—George Marshall, M.B.; Norman Bradley, M.D., William Henry Harris, M.B.; Reginald Leslie Norman.

Dated September 7, 1915.—Frank Lequesne Pelly, M.B.; Hamilton Joseph Bell, Thomas Francis Shackleton; Charles Game Angus Chislett, M.B.; George Francis Oldershaw, M.D.; William Shanks, M.B.; John Norman MacDonald; George Oliver Connell; Francis William Joynes; Frederick John Kirkness, M.B.; Alexander Goodsir Mowat, M.B.; Arthur Alan Miller, M.D.; Harold Percy Crampton, M.D.; Richard Wellington Shegog, M.B.; James Frank Hoare; Alfred Chad Turner Woodward, M.B., F.R.C.S.; William Hamish Donald; Frederick Walton Shilton.

Dated September 8, 1915.—James Leith Hendry; Gilbert William Charsley, M.B.; Wilfred Fairclough, M.B.; William Barbour Thompson, M.B.; Robert Edward Burnet Yelf, M.B.; Thomas Boyd Riddall, M.B.; Frederick Simpson, William Elisha Huff-Hewitt, M.B.; John Robson Dobbin, M.B.; Archibald Gardner, M.B.; John MacKinnon, M.B.; Charles Clouston Irvine; Lionel Matthew Rowlette; Claude Sebastian Van Renan Harwood, M.B.

Dated September 9, 1915.—Charles Roland Babington Eyre; James Denis O'Connor, M.B.; John Donald, M.D.; Archibald Gladstone Naismith, M.B.

Dated September 10, 1915.—Ernest George Fenton, F.R.C.S.I.; Alexander Collingwood Dickson; Richard Leonard Ley, M.B.; Oliver Armand James Needham Muriset, M.D.; Harold Trevor Marrable, M.D.; Thomas Kelly; Samuel Bryson, M.B.; Henry James Flanigan, F.R.C.S.I.; William Wilkinson Uttley, M.B.; Gustavus Herbert Powell; Clare Agustus Everest; Farquhar MacRae, M.B.; Horatio Minchin Hardy; Maurice Davidson, M.D.; Thomas Clifford Last, M.D.; Richard Fox; James MacMurchy Watson.

Dated September 11, 1915.—John Follett Bullar, M.B., F.R.C.S.; Richard Orderne Wilson, M.B.; George Murray Grant, M.B.; Henry Ireland Gascoyne Rutherford, M.B.; Edmond Doherty, M.B.; Edgar Smith.

Dated September 13, 1915.—Charles Satchell Pantin, M.D., F.R.C.S.; William Harris Best; George Errington Lloyd, M.D.; James Macmillan Anderson, M.B.; William Warburton, M.B.; Malcolm Edward Henry Wale; Napoleon Leonard, M.D.; Arthur Turnbull, M.B.; Archibald Stoddart-Walker, M.B.

Dated September 14, 1915.—Clement Massey Stubbs, M.B.; John Bennett Julius Lyttleton Dalby; George Frederick Fawn; Roswell Park, M.D.; William Norman Gilmour, M.D.; Herbert James Pegler.

Dated September 15, 1915.—John Clemence Bawden; John Hope Potter; Alfred Edward Huckett, M.B.; Herbert Malins, M.B., F.R.C.S.Edin.; Cecil Herbert Winter Page, M.D.; Arthur Evelyn Goldie, M.B.; Frederick George Martin; William Core, M.B.; James Harcourt Cecil Gatchell; Edward Thomas Jones; James McKail, M.B.; Frederick Baily Manser, M.B.

Dated September 16, 1915.—Lieutenant James Elvins McCartney, M.B., from The Worcestershire Regiment, Special Reserve; John Cuningham Bell; William Edmund Alexander Buchanan, M.B.; Robert Pettigrew Kennedy; George Atkin Hayman;

Richard John Aherne; Robert Noel Farrer; William Herbertson, M.B.; Andrew James Ferguson, M.B.; John Edward Rees; Eric William Craig, M.B.; Angus Hope Murch, M.B.

Dated September 17, 1915.—Ernest Charles MacKay, M.D.; Malcolm Edward Ball, M.B.; Alfred Stirling Hendrie, M.B.; Allan George Hamilton, M.D., F.R.C.S.Edin.; Philip Gettleson, M.D.

Dated September 18, 1915.—John Joule; Richard James Cane.

Dated September 19, 1915.—William Stanwell; Llewelyn Stanley Howard Glanville, M.D.

Dated September 20, 1915.—Albert Remington Hobbs, M.D.; Percy Rendall, M.D.; Duncan John McAfee, M.D.; Archibald Galbraith Faulds, M.B.; George Coats; Charles Robertson, M.B.; Archibald Grainger Bisset, M.B.; Edgar Giffith Evans; Edward Bromley, M.B; Francis Rupert Snell, M.B.; Ernest Alfred Pywell; Arthur Lerory Robinson; Herbert Augustus Hutt; Charles Berkeley Gervis, M.D.; Alfred Cecil Falkiner, M.B.; Mark Polson, M.B.; Richard Felton, M.D.; Norman McFarlane, M.B.; Meryn Eager; Elijah Brown; Hubert Horace Stones, M.B.; Vicars Maddison Fisher, M.B.; William Millerick; Duncan Fraser Macdonald, M.B.; Robert Anthony Fawcus, M.B.

Dated September 21, 1915.—Samuel Robbins Lane, M.D.; Gerald Lyme Parsons; Frederick Dillon, M.B.; James Alexander Brown, M.D.; Hector Menteith Robertson, M.B.; James Gardner, M.B.; George Frederick Charles.

The undermentioned to be temporary Honorary Lieutenants:—

Dated September 17, 1915.—Geoffrey Challen Linder.

Dated October 1, 1915.—David Hamilton Derry; Temporary Second Lieutenant James Donkin Cockburn, from The Highland Light Infantry.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated September 1, 1915.—Joseph Bulmer Thackeray; Arthur Graham Winter; Henry Hugh Mathias; Laurence Mansfield Ingle; James Arthur Liley.

The undermentioned Officers of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated August 21, 1915.—Captain James Henderson, M.D.; Lieutenant Harry Frederick MacKendrick, M.D.; Lieutenant Jermyn Oscar Baker, M.D.

Dated August 27, 1915.—Captain Cecil Roy Learn, M.D.

Dated September 4, 1915.—Victor George Williams, M.D.

Dated September 5, 1915.—Benjamin Franklin Keillor, M.B.

Robert Harvey to be temporary Quartermaster, with the honorary rank of Lieutenant, dated September 14, 1915.

The undermentioned relinquishes his commission:—

Dated August 20, 1915.—Temporary Major Thomas Kay, M.B.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated February 11, 1915.—Herbert M. Harrison.

Dated August 30, 1915.—Robert B. T. Stephenson, M.D.

Dated September 1, 1915.—Roy R. Kerr, M.B.

Dated September 2, 1915.—Clifford H. Brookes, M.D.; Richard Bright; William T. Milton, M.D.

Dated September 11, 1915.—John M. Glasse, M.B.

Dated September 14, 1915.—James L. Lawry, M.D.; John E. L. Keyes, M.B.; Maurice Nicoll, M.B.; Vincent Glendinning, F.R.C.S.

Dated September 16, 1915.—George E. Beaumont, M.B.; Patrick Cagney.

Dated September 17, 1915.—Vincent F. Lennane.

Dated September 23, 1915.—Michael J. Hackett, M.B.

Dated September 24, 1915.—Archibald Henderson, M.B.

Dated September 28, 1915.—Peter C. Lornie, M.B.; Arthur G. N. Goldney.

Dated October 7, 1915.—John I. Langley, on account of ill-health; Jerome O'Flynn, M.B., on account of ill-health.

Temporary Major Leslie H. Guest, dated September 30, 1915.

Major G. Horne, relinquishes his temporary honorary commission on ceasing to be employed with the Australian Voluntary Hospital, dated September 30, 1915.

Major T. J. Horder, M.D., relinquishes his temporary honorary commission on ceasing to be employed with No. 7 British Red Cross (Allied Forces Base) Hospital, dated October 7, 1915.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated July 16, 1915.—David Rose, whilst serving with the Allied Forces Base Hospital.

Dated August 5, 1915.—William Henry Turner.

Dated September 9, 1915.—Francis Henry Atkins.

Dated September 11, 1915.—William Henry Owen.

Dated September 15, 1915.—Arthur Dearsley.

Dated September 16, 1915.—Donald Hector Macdonald, George Drummond.

Dated September 21, 1915.—Richard William Bennett.

Dated September 24, 1915.—William Deans.

Dated September 26, 1915.—William Graham Lawson Fitchett.

Dated September 27, 1915.—Charles Wilson France.

Dated October 1, 1915.—William Singleton, Edward Thomas Smith.

Dated October 4, 1915.—Frank Gaiger.

SPECIAL RESERVE.

Royal Army Medical Corps.

Lieutenant Thomas D. Inch, M.B., to be Captain, with seniority next below C. N. Gover, dated April 1, 1915. (Substituted for the notification which appeared in the *Gazette* of September 9, 1915.)

Lieutenant (on probation) John T. Scrogie, M.B., is confirmed in his rank.

William Wallace Blair, M.B., to be Lieutenant (on probation), dated September 9, 1915.

The promotion to the rank of Captain of Lieutenant Ronald W. Duncan is as stated in the *Gazette* of September 9, 1915, and not as notified in the *Gazette* of July 26, 1915.

Lieutenant (on probation) Christopher G. Schurr is confirmed in his rank.

The undermentioned Lieutenants to be Captains:—

Dated September 1, 1915.—John D. MacCormack, Robert H. Williams.

Dated September 17, 1915.—George H. Haines.

Dated September 20, 1915.—Stanley B. King.

Dated September 22, 1915.—John R. Crolius.

Dated September 25, 1915.—Frederick McKibbin, M.B.

Dated September 29, 1915.—Edmund Robinson, M.B.; Arthur C. Bateman.

Captain Samuel Wright resigns his commission on account of ill-health, dated September 19, 1915.

The promotion to the rank of Captain of Lieutenant Richard P. Ballard, M.B.; notified in the *Gazette* of July 23, 1915, bears date April 7, 1915, and not as therein stated.

Second Lieutenant Robert Fowler Walker, M.B., to be Lieutenant (on probation), dated September 1, 1915.

The undermentioned Lieutenants (on probation) are confirmed in their rank: John M. Watt, Robert L. Impey, Peter W. Edwards, Thomas F. Corkhill, Arthur McM. Paterson, Roderic D. Cameron, Walter B. Foley, M.B., Thomas Y. Barkley, M.B., Edwin N. H. Gray, Reginald C. Eades, Raymond Stowers, Alan R. Laurie, M.B., Robert F. Walker, M.B., John W. Malcolm.

TERRITORIAL FORCE.

Royal Army Medical Corps.

London Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Thomas W. S. Paterson, dated April 1, 1915; Edward B. Hartnell, dated April 1, 1915; Herbert E. Roaf, dated April 1, 1915; Frederick P. Rankin, M.B., dated April 20, 1915; Ernest G. T. Poynder, dated August 1, 1915. Captain John P. MacLulich, M.D., resigns his commission on account of ill-health, dated October 2, 1915.

2nd London (City of London) General Hospital.—Albert James Walton to be Captain, whose services will be available on mobilization, dated October 3, 1915; Frederick Douglas Selmes Jackson to be Lieutenant, dated October 3, 1915; Leslie Norman Reece to be Lieutenant, dated October 8, 1915.

2nd London Sanitary Company.—Percy Edward Lander to be Lieutenant, dated September 4, 1915; Lieutenant Frederick J. J. Ney to be Captain, dated September 19, 1915; Alexander Middleton Brown, M.B., to be Lieutenant, dated September 21, 1915; James Chalmers, M.B., to be Lieutenant, dated September 21, 1915; Captain Charles A. Spooner, from Attached to Units other than Medical Units, to be Captain, dated October 7, 1915; Robert Hutchison Murray to be Lieutenant, dated October 14, 1915.

4th London General Hospital.—The date of appointment of Lieutenant William K. Churchouse is August 23, 1915, and not as stated in the *London Gazette* of September, 27, 1915.

6th London Field Ambulance.—Lieutenant Frederick L. Golla, M.B., to be Captain, dated April 1, 1915.

2nd Home Counties Field Ambulance.—Major (temporary Lieutenant-Colonel) Antony A. Martin, M.D., relinquishes his temporary rank of Lieutenant-Colonel on alteration in posting, dated September 12, 1915; Major George T. Willan to be temporary Lieutenant-Colonel, dated September 19, 1915; Driver Leighton Maurice Greaves, from 2nd South Midland Mounted Brigade Field Ambulance, to be Transport Officer, with the honorary rank of Lieutenant, dated October 6, 1915.

3rd Home Counties Field Ambulance.—The undermentioned Lieutenants to be Captains: William Cummings, M.B., dated September 5, 1915; John F. Molyneux, M.D., dated September 9, 1915.

Wessex Casualty Clearing Station.—Captain Frank A. Roper, M.B., from 1st Wessex Field Ambulance, to be Captain, dated October 8, 1915; Thomas James Wright to be Lieutenant, dated October 10, 1915.

1st Wessex Field Ambulance.—Captain Richard Eager, M.B., to be temporary Major, dated September 28, 1915; Captain John G. Macindoe, M.B., from 6th Battalion, The Devonshire Regiment, to be Captain, dated September 29, 1915.

3rd Wessex Field Ambulance.—Lieutenant James Kearney to be Captain, dated April 14, 1915; Horace James Pechell, M.B. (late Captain, Territorial Force Reserve, General List), to be Captain, dated October 2, 1915.

East Anglian Divisional Sanitary Section.—The date of appointment of Captain Walter F. Corfield, M.D., is June 11, 1915, and not as stated in the *London Gazette* of June 19, 1915.

1st East Anglian Field Ambulance.—The undermentioned Lieutenants to be Captains: James L. M. Symms, dated April 1, 1915; Harry Whitaker, M.B., dated April 8, 1915; Thomas V. Oldham, M.B., dated April 15, 1915; Laurence H. Hutchins, dated May 14, 1915; Hugh F. G. Hall, M.B., dated July 25, 1915; Ambrose C. Wilson, dated August 11, 1915.

2nd East Anglian Field Ambulance.—The undermentioned Lieutenants to be Captains: Thomas A. Flynn, dated April 1, 1915; Ernest B Hinde, M.B., F.R.C.S., dated April 1, 1915; Edmund A. Goulden, M.D., dated August 3, 1915; Benjamin B. Morgan, M.D., dated April 1, 1915.

3rd East Anglian Field Ambulance.—The undermentioned Lieutenants to be Captains: William T. Crawford, M.B., dated April 1, 1915; George H. Harper Smith, M.D., dated April 8, 1915; Raymond H. Swindells, M.B., dated May 19, 1915; Edward C. Hobbs, dated June 2, 1915; John N. Robins, dated September 10, 1915; the date of appointment of Lieutenant Frederick C. Kempson, M.B., is September 23, 1914, and not as stated in the *London Gazette* of October 14, 1914; Cadet Roy Dyson Langdale-Kelham, from University of London Contingent, Senior Division, Officers Training Corps, to be Lieutenant, dated October 2, 1915; William Kingdon Legassick to be Lieutenant, dated October 10, 1915.

Notts and Derby Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Herbert S. Wallace, M.B., dated April 1, 1915; Douglas J. Marr, M.B., dated April 15, 1915.

South Wales Mounted Brigade Field Ambulance.—Lieutenant Guy S. Thompson, to be Captain, dated April 1, 1915; Lieutenant Herbert M. Pentreath to be Captain, dated April 10, 1915; Norman Frederic Richardson to be Transport Officer, with the honorary rank of Lieutenant, dated August 26, 1915.

1st Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: Arvor Jones, dated April 1, 1915; Joseph M. Fonseca, dated April 1, 1915; John Clarke, dated April 24, 1915; Vaughan Bateson, dated May 14, 1915.

2nd Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: John Wallace M.B., dated April 1, 1915; Arthur F. B. Shaw, M.D., dated April 1, 1915; the date of promotion of Lieutenant Charles W. C. Myles, M.B., to Captain, is April 1, 1915, and not as stated in the *London Gazette* of June 8, 1915; Barry K. T. Collins; dated May 23, 1915; Evan D. Richards, dated July 2, 1915.

3rd Welsh Field Ambulance.—The undermentioned Lieutenants to be Captains: Hamilton E. Quick, M.B., F.R.C.S., dated April 1, 1915; Peyton T. Warren, dated April 1, 1915; William Rutherford, M.B., dated April 10, 1915; William J. Richards, F.R.C.S., dated April 18, 1915; George Young, M.B., dated April 19, 1915.

Welsh Casualty Clearing Station.—The undermentioned Lieutenants to be

Captains: Charles Nyhan, dated April 1, 1915; John J. E. Biggs, dated April 20, 1915; The date of appointment of Quartermaster and Honorary Lieutenant Frederic J. L. Gribble is May 27, 9115, and not as stated in the *London Gazette* of July 26, 1915; John H. Robinson, dated June 1, 1915: Major Richard T. Turner, M.D., from Attached to Units other than Medical Units, to be Major, dated July 7, 1915; Lieutenant John H. Robinson, from Attached to Units other than Medical Units, to be Lieutenant, dated October 2, 1915.

1st North Midland Field Ambulance.—Lieutenant John W. Thomson, M.B., to be Captain, dated April 23, 1915; Lieutenant Frank P. Sturm, M.B., to be Captain, dated September 15, 1915.

2nd North Midland Field Ambulance.—Lieutenant Hubert Pinto-Leite to be Captain, dated April 1, 1915.

North Midland Mounted Brigade Field Ambulance.—Lieutenant Fred H. Davies, M.B., to be Captain, dated April 26, 1915.

1st South Midland Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Henry E. McCready, M.D.; William Bowater; Morris Wilks, M.B.; Henry P. Thomason, M.B.; Lieutenant William J. Hirst, M.B., to be Captain, dated September 17, 1915; George Henry Hart (late Captain, 1st Volunteer Battalion, Royal Warwickshire Regiment) to be Captain (temporary), dated September 20, 1915.

1st South Midland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: William T. Torrance, dated April 1, 1915; Robert W. Aitken, M.B., dated April 1, 1915; Cyril R. Wallace, dated April 1, 1915; Alexander Mitchell, M.B., dated April 3, 1915; William George Rutherford to be Lieutenant, dated September 13, 1915; Samuel Percy Johnson, M.B. (late Surgeon-Lieutenant, 1st Warwickshire Royal Garrison Artillery (Volunteers)), to be Lieutenant, dated October 2, 1915.

2nd South Midland Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: Ralph A. Broderick, M.B.; William J. C. B. Pitt; Kenneth A. P. R. Murray; Albert E. P. McConnell, M.B.; Staff-Serjeant James Bannerman, from the Edinburgh University Contingent, Senior Division, Officers Training Corps, to be Lieutenant, dated September 9, 1915.

2nd South Midland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: Humphrey F. Humphreys, M.B., dated April 1, 1915; George A. Auden, M.D., dated April 1, 1915; William E. H Bull, dated April 15, 1915; Lieutenant Henry J. Blackler, M.B, to be Captain, dated August 10, 1915.

3rd South Midland Field Ambulance.—The undermentioned Lieutenants to be Captains: John P. I. Harty, M.B., dated April 1, 1915; Henry J. D. Smythe, dated April 1, 1915; James G. McLaunahan, dated April 1, 1915; Richard I. Dacre, dated May 26, 1915.

South Midland Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Laurence Ball, M.B., dated May 22, 1915; Henry G. Langdale-Smith, M.B., dated May 27, 1915; Leonard J. Moir, M.B., dated June 4, 1915. Charles William Tressider Baldwin to be Lieutenant, dated October 13, 1915.

1st Eastern General Hospital.—Thomas Shirley Hele, M.D. (late Captain, Unattached List for the Territorial Force) to be Major (temporary) on the permanent personnel, dated August 14, 1915; Ernest Newton Hoffmeister to be Lieutenant, dated October 13, 1915; Geoffrey Alwyn Gershom Bonser to be Lieutenant, dated October 15, 1915.

2nd Eastern General Hospital.—Lieutenant Cyril C. Messiter to be Captain, dated September 3, 1915.

Eastern Mounted Brigade Field Ambulance.—Lieutenant John M. O'Meara, M.B., to be Captain, dated April 10, 1915; Lieutenant James Lamberton, M.B.; to be Captain, dated September 18, 1915.

South Eastern Mounted Brigade Field Ambulance.—Transport Officer and Honorary Captain Lewis H. Coles tc be Transport Officer, with the honorary rank of Major, dated March 18, 1915.

2nd Western General Hospital.—Lieutenant Manfred Moritz, M.B., to be Captain, dated June 1, 1915; Lieutenant-Colonel John W. Smith, M.D., from the permanent personnel, to be Lieutenant-Colonel, whose services will be available on mobilization, dated October 2, 1915.

1st Northern General Hospital.—Herbert Wallace Kerrigan, M.B., to be Lieutenant, dated September 1, 1915; Major Frederick C. Pybus, M.B., F.R.C.S., is restored to the Establishment, dated October 7, 1915.

2nd Northern General Hospital.—John William Walker to be Captain, whose services will be available on mobilization, dated August 28, 1915; Captain Alfred H. Horsfall, D.S.O., M.B., to be temporary Major, and seconded for duty with an Ambulance, dated October 10, 1915.

4th Northern General Hospital.—Major William A. Carline, M.D., to be Lieutenant-Colonel, whose services will be available on mobilization, dated October 3, 1915.

1st Southern General Hospital.—Serjeant-Major Thomas Samuel Pettitt to be Quartermaster, with the honorary rank of Lieutenant, dated October 12, 1915.

3rd Southern General Hospital.—Robert Hitchings to be Lieutenant, dated September 4, 1915; Samuel Ernest Whitnall, M.B., to be Lieutenant, dated September 14, 1915.

1st East Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Alexander M. Mackay, M.B., dated April 1, 1915; John Morley, M.B., F.R.C.S., dated April 1, 1915; Frederick S. Bedale, dated April 1, 1915; Leonard E. H. R. Barker, M.B., dated June 11, 1915; Gilbert Bailey, dated July 8, 1915; Robert S. Young, M.B., dated July 24, 1915.

2nd East Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Clement A. Webster, dated April 1, 1915; George B. Jameson, dated April 1, 1915; Frederick C. Bentz, M.B., dated April 1, 1915; William Turner, dated May 4, 1915; Alexander M. Gibson, M.B., dated May 4, 1915; William J. Cowan, dated May 26, 1915; John J. Hummel, M.B., dated June 20, 1915.

3rd East Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Arthur M. Johnson, M.D., dated April 1, 1915; Nicholas H. H. Haskins, M.B., dated April 1, 1915; Oliver H. Blacklay, M.D., dated April 1, 1915; Frank G. Prestwich, dated May 5, 1915; James A. Tomb, M.B., dated June 1, 1915; Frederic B. Smith, dated June 7, 1915; Henry Wilson, M.B., dated June 24, 1915.

1st West Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: James Walker, M.B., dated April 1, 1915; Samuel McCausland, dated April 1, 1915; Thomas Courtenay Clarke, M.B., dated April 1, 1915; Harold Seddon, M.B., dated April 1, 1915; William Evans Graham, M.B., dated April 22, 1915; Frederick Ryan, M.B., dated June 14, 1915.

2nd West Lancashire Field Ambulance.—Lieutenant Robert G. Wills, M.B., to be Captain, dated April 1, 1915.

3rd West Lancashire Field Ambulance.—Lieutenant Sandys J. C. Holden, M.B., to be Captain, dated June 15, 1915.

2nd West Riding Field Ambulance.—Lieutenant Wallace W. Adamson, M.B., to be Captain, dated April 10, 1915.

3rd West Riding Field Ambulance.—Captain George E. St. C. Stockwell, M.B. 7th Battalion, West Yorkshire Regiment, to be Captain (temporary), dated September 9, 1915.

2nd Northumbrian Field Ambulance.—Lieutenant James G. Hill, M.B., to be Captain, dated September 24, 1915.

3rd Northumbrian Field Ambulance.—Transport Officer and Honorary Lieutenant John Riley is seconded, dated September 29, 1915.

Northumbrian Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Robert W. Smith, M.B., dated September 12, 1915; Frederick S. Walker, M.D., dated September 16, 1915.

1st Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains: Arthur D. Downes, M.B., dated April 1, 1915; William C. Gunn, M.B., dated April 1, 1915; Robert S. Taylor, M.B., dated April 1, 1915; Arthur W. Sutherland, M.B., dated April 29, 1915; George B. Eadie, M.D., dated, April 29, 1915; Percival J. Moir, M.B., dated April 29, 1915. Robert Watson, to be Lieutenant, dated August 10, 1915.

2nd Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains: William H. Manson, M.D., dated April 1, 1915; James W. Burton, M.B., dated April 12, 1915. William Combe, M.B., to be Lieutenant, dated September 15, 1915.

3rd Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains: Andrew J. Brown, dated April 1, 1915; William W. Greer, M.D., F.R.C.S.Edin., dated April 1, 1915; Rankine G. Walker, M.B., dated April 1, 1915; Arthur J. G. Hunter, M.D., F.R.C.S.Edin., dated April 1, 1915; Archibald M. Stewart, M.B., dated April 1, 1915; Clifford H. K. Smith, M.B., dated May 1, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of August 17, 1915: James Wilfred George Hewat Riddel (late Second Lieutenant, 1st Lowland Brigade, Royal Field Artillery), to be Lieutenant, dated July 21, 1915;

Quartermaster-Serjeant Thomas James Carbarns, to be Quartermaster, with the honorary rank of Lieutenant, dated October 5, 1915.

1st Highland Field Ambulance.—The undermentioned Lieutenants to be Captains: James A. Morris, M.B., dated April 1, 1915; James E. G. Thomson, M.B., dated April 1, 1915; Daniel M. Grant, M.B., dated April 8, 1915; James S. McConnachie, M.B., dated April 8, 1915; Charles A. Whyte, dated April 15, 1915; George Davidson, M.D., dated April 16, 1915; Bernard G. Beveridge, M.B., dated May 21, 1915. Thomas Priest to be Qurrtermaster, with the honorary rank of Lieutenant, dated October 5, 1915.

2nd Highland Field Ambulance.—The undermentioned Lieutenants to be Captains: Alexander C. Mallace, M.B., dated April 1, 1915; George Henderson, dated April 1, 1915; Hawtrey W. Browne, M.B., dated April 1, 1915; George S. Melvin, M.B., dated April 20, 1915: Robert T. Bruce, M.D., dated May 13, 1915. The date of appointment of Lieutenant Alexander Main Baillie, M.B., is July 29, 1915, and not as stated in the *London Gazette* of September 3, 1915. The date of appointment of Lieutenant Harry Gordon Donald, M.B., is July 30, 1915, and not as stated in the *London Gazette* of September 3, 1915. The date of appointment of Lieutenant John William McKeggie, M.B., is July 31, 1915, and not as stated in the *London Gazette* of September 3, 1915. The date of appointment of Lieutenant James Alexander Sellar, M.B., is August 7, 1915, and not as stated in the *London Gazette* of September 3, 1915.

3rd Highland Field Ambulance.—The undermentioned Lieutenants to be Captains, dated April 1, 1915: John Strathearn, M.D., F.R.C.S.Edin., George B. Killoh, M.B.; John M. Milne, dated April 15, 1915; George McConnell, M.B., dated May 4, 1915; Thomas C. Britton, M.B., dated May 4, 1915.

Highland Mounted Brigade Field Ambulance.—Major John W. Mackenzie, M.D., to be temporary Lieutenant-Colonel, dated September 7, 1915; Captain Lachlan M. V. Mitchell, M.B., to be temporary Major, dated September 7, 1915.

Scottish Horse Mounted Brigade Field Ambulance.—Lieutenant Frederick G. Harper, M.D., to be Captain, dated September 1, 1915.

1st Scottish General Hospital.—Lieutenant Ian G. Bisset, M.B., to be Captain, dated September 8, 1915.

2nd Scottish General Hospital.—The date of appointment of Lieutenant John Watson Simpson, M.B., is July 9, 1915, and not as stated in the *London Gazette* of August 14, 1915.

Sanitary Service.

The following announcement is substituted for that which appeared in the *London Gazette* of December 22, 1914:—

Captain Herbert E. Corbin, from attached to Units other than Medical Units, to be Captain, and appointed Sanitary Officer, East Lancashire Division, dated September 28, 1914.

The undermentioned Captains to be Majors, dated October 10, 1915:—

Davy T. Belding.
David Rennet, M.D.
Robert A. Dunn, M.D.
John Murray, M.B.
William B. Barclay.
William Butler, M.B.
Arthur M. N. Pringle, M.B.
Marcus G. Yunge-Bateman.
Harold Scurfield, M.D.
Duncan Forbes, M.D.

Attached to Units other than Medical Units.

The undermentioned Lieutenants to be Captains:—

Alexander S. M. Macgregor, M.D., dated April 1, 1915.
William T. Gardiner, M.B., F.R.C.S.Edin., dated April 1, 1915.
Edmund F. Rose, dated April 1, 1915.
John A. Parsons, M.D., dated April 1, 1915.
Charles M. Mitchell, dated April 1, 1915.
Herbert V. Capon, dated April 1, 1915.
Gerald L. Bunting, M.D., dated April 1, 1915.
Duncan F. Macrae, M.B., dated April 1, 1915.

Thomas Carnwath, M.B., dated April 1, 1915.
Charles W. Wirgman, M.D., F.R.C.S., dated April 1, 1915.
Alfred N. Crawford, F.R.C.S.I., dated April 1, 1915.
John Livingston, F.R.C.S.Edin., dated April 1, 1915.
John F. Edmiston, M.B., dated April 1, 1915.
Arthur H Faulkner, dated April 1, 1915.
Robert A. Kerr, M.B., dated April 1, 1915.
Kenneth D. Wilkinson, M.B., dated April 1, 1915.
Arnold Morris, dated April 1, 1915.
Francis H. Sprague, dated April 1, 1915.
Douglas E. Finlay, M.B., dated April 1, 1915.
Duncan Davidson, M.B., dated April 1, 1915.
George F. R. Smith, M.B., dated April 1, 1915.
William George, M.B., dated April 1, 1915.
Archibald Cambell, dated April 1, 1915.
Frank Clayton, M.D., dated April 1, 1915.
Oswald L. Scarborough, dated April 1, 1915.
Alexander K. Maclachlan, M.B., dated April 1, 1915.
James G. Hayes, dated April 1, 1915.
Charles F. Searle, M.B., dated April 1, 1915.
Frederick C. Kempson, M.B., dated April 1, 1915.
William S. McCune, M.B., dated April 1, 1915.
George J. M. Martin, dated April 1, 1915.
Arthur E. Bullock, M.B., dated April 1, 1915.
Alastair R. Grant, M.B., dated April 1, 1915.
John Morris, M.B., F.R.C.S., dated April 1, 1915.
Theophilus W. Morcom-Harneis, dated April 1, 1915.
Walter R. Bristow, M.B., F.R.C.S., dated April 1, 1915.
Leonard B. Baird, dated April 1, 1915.
George B. Pearson, dated April 1, 1915.
Grahame Patton, dated April 1, 1915.
William J. Phillips, M.B., dated April 1, 1915.
Leonard West, M.B., dated April 1, 1915.
William J. H. Davis, dated April 1, 1915.
William L. Burgess, M.D., dated April 3, 1915.
William E. Fitzgerald, M.B., dated April 6, 1915.
Andrew P. Granger, M.B., dated April 12, 1915.
Pierce N. Creagh, dated April 15, 1915.
James G. F. Hosken, dated April 15, 1915.
Alfred H. T. Andrew, M.B., dated April 24, 1915.
Sidney H. Clarke, M.D., dated April 24, 1915.
John G. Morgan, dated April 28, 1915.
Gordon Whitehead, M.B., dated May 3, 1915.
Arthur J. Friedlander, dated May 3, 1915.
George D. Thomson, dated May 5, 1915.
Robert G. McD. Ladell, M.B., dated May 7, 1915.
John K. Syms, dated May 9, 1915.
Robert D. Cran, dated May 11, 1915.
George R. E. G. Mackay, M.B., dated May 14, 1915.
Charles G. Tench, M.B., dated May 14, 1915.
George Crawshaw, M.B., dated May 23, 1915.
Rowland L. Thomas, dated May 26, 1915.
Ralph A. Burditt, dated June 4, 1915.
Thomas J. Thomson, M.D., dated June 7, 1915.
Percy H. Burton, dated June 15, 1915.
Lancelot W. Sparrow, M.B., dated June 18, 1915.
Ashley S. Hopper, M.B., dated June 30, 1915.
Michael Brannan, M.B., dated July 1, 1915.
Gerald A. Child, dated July 5, 1915.
Leslie E. Hughes, dated July 12, 1915.
Hugh A. Sandiford, M.B., dated July 15, 1915.
William A. Phillipps, M.D., dated July 18, 1915.
Henry F. J. Graves, dated August 8, 1915.
Ernest Osborne, dated August 18, 1915.

Berkeley N. Ash, dated August 26, 1915.
John R. B. Russell, M.B., dated August 28, 1915.
Francis Field Cunningham Jagger, M.B., to be Lieutenant, dated August 28, 1915.
Joseph L. Baskin, dated September 2, 1915.
Herbert Smith to be Lieutenant, dated September 2, 1915.
Frank Jeffree, M.D., dated September 3, 1915.
Archibald Jubb, M.D., dated September 5, 1915.
James M. Heron, M.D., dated September 18, 1915.
Donald Grant Dingwall to be Lieutenant, dated September 20, 1915.
Reginald D. Moore, dated September 22, 1915.
Wilfred Winnall Horton, M.D., to be Lieutenant, dated September 24, 1915.
Albert Edward Evans, M.B., to be Lieutenant, dated October 15, 1915.

TERRITORIAL FORCE NURSING SERVICE.

Miss Sarah Jane Cockrell to be Matron, 4th London General Hospital, dated October 1, 1915.

TERRITORIAL FORCE RESERVE.

ROYAL ARMY MEDICAL CORPS.

Lieutenant John C. Jefferson, M.B., F.R.C.S., from 3rd East Lancashire Field Ambulance, to be Lieutenant, dated May 7, 1915.

Major Hugh N. A. Taylor, M.D., F.R.C.S., from attached to Units other than Medical Units, to be Major, dated October 8, 1915.

Major John E. W. McFall, M.D., from 1st West Lancashire Field Ambulance, to be Major, dated October 10, 1915.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE ON WEDNESDAY, OCTOBER 13, 1915, AT 3 P.M., IN ROOM 356.

Present:—

Surgeon-General M. W. Russell in the Chair.
Lieutenant-Colonel W. W. Pope.
Lieutenant-Colonel W. Blackwell.
Major W. A. Ward.

A letter was read from Surgeon-General Sir David Bruce, C.B., apologising for his absence.

(1) The Minutes of the last Meeting were read and confirmed.

(2) The grants made to recipients from the General Relief Fund for the half year ending September 30, were considered and passed.

(3) The grants received from companies for the General Relief Fund during the half year ending September 30 were noted.

(4) Sanction was given for a grant of £100 from the General Relief Fund to the R.A.M.C. Comfort Fund for supplying comforts to our men at the Front and to our Prisoners of War.

(5) It was noted that a cheque for £30 has been received from Lady Saunders and Miss Eastman, being part of the proceeds of a concert organized by them in Zululand; to be earmarked for the wounded Royal Army Medical Corps. A letter of thanks from the Committee was sent to them.

(6) It was noted that the sum of £150 voted at the last Annual General Meeting has been sent to the executors of the late Colonel W. Johnston, towards the expenses of the publication of his book on the "History of the Corps." A letter of thanks has been received from Mrs. Johnston.

(7) A letter was read from the Secretary of the Royal Soldiers' Daughters' Home, asking for the removal of a girl from the School, on the ground that she was not likely to become efficient for domestic service.

(8) A letter was read which had been forwarded by the War Office enclosing an application from the widow of the late Captain W. J. Crofton, R.A.M.C., asking for an increase of her pension. The Secretary was directed to reply that the application does not come within the scope of the Royal Army Medical Corps Fund.

(9) It was noted that a sum of £800 belonging to the Royal Army Medical Corps Fund and a sum of £600 of the General Relief Fund have been invested in the new War Loan. The money was transferred from the deposit account for the purpose.

(10) It was decided to ask Surgeon-General F. J. Jencken if he would consent to become an Auditor to the Fund vice Colonel Julian, C.M.G.

(11) A letter was read from the British Consul at Casablanca, Morocco, forwarding an application from Mr. Alfred Lawrence, late Royal Army Medical Corps, asking for a grant from the General Relief Fund. It was resolved that a negative reply should be sent as Mr. Lawrence could obtain employment, if he so wished, either at Gibraltar or at home.

(12) With reference to Minute 4 of the last Committee Meeting, it was resolved to retain the Bandmaster's services until the end of 1916, and it was further decided that a sum not exceeding £175 be expended on the Band next year.

(13) It was proposed by Lieutenant-Colonel Pope and resolved that a circular letter be sent to retired re-employed officers, who are not subscribers to the Fund, asking them to become subscribers.

LISTS OF RECIPIENTS OF GRANTS FROM THE GENERAL RELIEF FUND FOR THE HALF YEAR ENDING SEPTEMBER 30, 1915.

No.	Name	Age	District	Grant	Total	Remarks
475	Mrs. T. G. A.	—	London	£1	£8	Destitution.
476	Miss H. M.	15	Portsmouth	4	20	Sanctioned by Committee.
477	Mrs. A. T. T.	58	Aldershot	3	5	Ill-health; unable to work.

GRANTS RECEIVED FROM COMPANIES AND UNITS FOR THE GENERAL RELIEF FUND DURING THE SIX MONTHS ENDING SEPTEMBER 30, 1915.

	£	s.	d.
Aldershot	£200	0	0
Netley	30	0	0
Woolwich	17	10	0
Colchester	50	0	0
Devonport	10	0	0
Chatham	10	0	0
Belfast	10	0	0
Dover	9	5	7
Cork	3	0	0
Shorncliffe	4	0	0
Cosham	5	0	0
Rochester Row	1	0	0
Gibraltar	4	0	0
Malta	£8	5	0
Training Centre—			
Limerick	5	5	0
Sling	10	0	0
Llandrindod Wells	10	0	0
Serjeants' Mess—			
Cairo	5	0	0
Gibraltar	4	0	0
Sling	5	0	0
No. 43 Field Ambulance	1	14	9
	£403	0	4

ROYAL SCHOOL FOR DAUGHTERS OF OFFICERS, BATH.

NOVEMBER ELECTION, 1915.

VOTES and interest until election are requested on behalf of Margaret McCulloch, born September, 1902. Second daughter of the late Lieutenant-Colonel T. McCulloch, M.B., R.A.M.C.

The case is known and recommended by Surgeon-General Sir W. Taylor, K.C.B., M.D., K.H.P.; Surgeon-General Sir W. L. Gubbins, K.C.B., M.V.O., M.B.; Brigadier-General W. Baker Brown, R.E.

Lieutenant-Colonel T. McCulloch served for twenty-eight years in the R.A.M.C., including ten years in India. He was employed at the War Office from 1902 to 1906. and saw active service in the China Campaign, 1900 to 1901.

Mrs. McCulloch is left with three children, two girls aged 17 and 13, and a boy, aged 9, and with only a very small private income to supplement her pension. Her eldest son, Lieutenant R. A. D. McCulloch, The King's Own Royal Lancaster Regiment, was killed at the Front in May, 1915.

STATEMENT OF ACCOUNTS FROM JULY 1, 1914, TO JUNE 30, 1915.

BALANCE SHEET.

Liabilities.	£	s.	d.	Assets.	£	s.	d.	£	s.	d.
To Publishers' Bill for June Quarter, 1915	325	4	7	By Cash at Bank				778	3	4
,, ,, March Quarter, 1915	219	3	6	,, Value Stamps in Hand				1	8	8
,, Balance Credit	2,393	1	2	,, Investments at Minimum Price—						
				£1,000 India Stock at 80¾ ..	£807	10	0			
				£1,500 Consols at 65	975	0	0			
				£200 Tasmanian Stock at 94 ..	188	0	0			
								1,970	10	0
				,, Furniture, etc., as per last Balance Sheet	21	10	3			
				Written off for depreciation ..	2	3	0			
								19	7	3
				,, Outstanding for Subscriptions				53	0	0
				,, Do. Advertisements				115	0	0
	£2,937	9	3					£2,937	9	3

TRADING ACCOUNT.

FROM JULY 1, 1914, TO JUNE 30, 1915.

EXPENDITURE.

	£ s. d.
To Publishers' Bills—	
Journal	1,001 9 10
Corps News	198 2 8
Calendars	20 3 6
Reprints	6 9 0
Envelopes, Postage and Packing	51 18 3
Sundries	2 16 8
,, Balance to Profit and Loss Account	318 11 7
	£1,599 11 6

RECEIPTS.

		£ s. d.	£ s. d.
By Subscriptions to Journal		1,136 11 8	
,, ,, Outstanding June 30, 1915		53 0 0	
		1,189 11 8	
Deduct Subscriptions credited in error	£2 1 0		
Deduct Subscriptions outstanding June 30, 1914	1 0 0		
		3 1 0	
			1,186 10 8
By Subscriptions to Corps News			18 14 3
,, ,, Seniority Rolls			9 4 1
,, ,, Calendars			0 12 3
,, Receipts for Covers and Binding			0 3 0
,, ,, ,, Reprints			0 14 9
,, Advertisements			221 5 0
,, Sales through Manager			0 19 10
,, ,, ,, Publishers			161 7 8
			£1,599 11 6

PROFIT AND LOSS ACCOUNT.

From July 1, 1914, to June 30, 1915.

Expenditure.

	£ s. d.	£ s. d.
To Business Manager's Account—		
Clerk to Manager	24 0 0	
,, Editor	12 12 0	
Postages	8 19 7	
Stationery..	0 19 0	
Postman	1 0 0	
		47 10 7
,, Honorarium to Editor..		100 0 0
,, ,, Auditor		2 2 0
,, Exchange on Drafts		0 1 9
,, Refund for Reprints not Supplied		0 14 9
,, Written off for Depreciation of Furniture ..		2 3 0
,, ,, ,, Investments ..		404 17 9
,, Balance carried to Balance Sheet—		
Balance, July 1, 1914	2,558 5 3	
Less Net Loss during the year..	165 4 1	
		2,393 1 2
		£2,950 11 0

Receipts.

	£ s. d.
By Balance from last Account	2,558 5 3
,, Gross Profit on Trading Account	318 11 7
,, Interest on India Stock	32 1 0
,, ,, Consols	34 6 10
,, ,, Tasmanian Stock	7 6 4
	£2,950 11 0

(Signed) H. BARROW, *Lieut.-Colonel, R.A.M.C.*
Hon. Manager, Journal R.A.M.C.

Examined and found correct,
(Signed) EDMOND T. GANN.

September 30, 1915.

DEATHS.

CROKER.—Surgeon Lieutenant-Colonel John Randal Croker, retired Army Medical Staff, died at Herne Bay, on September 29, 1915, aged 75.

CUFFE.—Surgeon-General Sir Charles MacDonogh Cuffe, K.C.B., F.R.C.S.Edin., retired, Army Medical Staff, died at 2, Cadogan Gardens, London, S.W., on October 4, 1915, aged 73.

GRAY.—Surgeon-Major Charles Gray, retired, Medical Department, died at 13, Elvaston Place, South Kensington, on September 25, 1915, aged 81.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, *Serle Street, London, W.C., not later than the* 22*nd of the month.*

Captain, R.A.M.C., completed over six years in India, willing to exchange with any war-worn officer desirous of a rest. Premium. Apply "F.G.," c/o Holt & Co., 3, Whitehall Place, London.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts *	Extra for Covers for Reprints			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 6	0 1 0	3 6	0 11	3 2	0 7
	8	0 4 6	0 2 0				
	16	0 7 6	0 3 6				
25	4	0 3 0	0 1 3	4 0	1 3	3 6	0 9
	8	0 5 6	0 2 6				
	16	0 9 6	0 4 6				
50	4	0 4 0	0 1 8	5 0	1 9	4 0	1 0
	8	0 6 9	0 3 2				
	16	0 12 0	0 5 3				
100	4	0 5 6	0 2 9	6 6	3 3	5 6	2 0
	8	0 9 0	0 4 4				
	16	0 16 9	0 6 9				
200	4	0 8 6	0 4 0	9 0	6 3	7 6	4 0
	8	0 13 6	0 6 0				
	16	1 3 6	0 8 9				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 1s. 4d. net; binding, 1s. 2d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Surgeon-General W. G. Macpherson, Professor S. Delépine, Temporary Lieutenant-Colonel R. T. Leiper, Major G. H. Brown, Captain A. Abrahams, Captain R. L. Scott.

The following publications have been received:—

British: The Sanitary Record and Municipal Engineering, Red Cross and Ambulance News, The Hospital, The Medical Journal of South Africa, The Lancet, The Medical Journal of Australia, The Journal of Tropical Medicine and Hygiene, The Medical Press and Circular, The Medical Review, Tropical Veterinary Bulletin, Proceedings of the Royal Society of Medicine, The Middlesex Hospital Journal, Public Health, The British Journal of Tuberculosis.

Foreign: Bulletin de l'Institut Pasteur, Annali di Medicina Navale e Coloniale, United States Public Health Service, Revista de Sanidad Militar, Office International d'Hygiène Publique, Proceedings of the Medical Association of the Isthmian Canal Zone.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

The Hon. Manager,
"Journal of the Royal Army Medical Corps,"
War Office, Whitehall, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

SEPTEMBER AND OCTOBER, 1915.

HIS MAJESTY THE KING has been graciously pleased to give orders for the following promotions in, and appointment to, the Most Honourable Order of the Bath, for distinguished service in the Field:—

To be Additional Member of the Military Division of the Third Class, or Companion, of the said Most Honourable Order:—

Lieutenant-Colonel John Hennessy, M.B., Royal Army Medical Corps.

War Office,
October 29, 1915.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned Officers to be Companions of the Distinguished Service Order, in recognition of their gallantry and devotion to duty in the Field:—

Major Henry Arthur Bransbury, Royal Army Medical Corps.

Captain Bertram Sibbald Finn, New Zealand Medical Corps.

For conspicuous devotion to duty in the Gallipoli Peninsula during operations from August 6 to 9, 1915, when he worked day and night with unceasing zeal and without rest, evacuating the wounded. His work was carried out under continuous fire, on one occasion the dressing station being heavily shelled for an hour, and many assistants and wounded being hit. Owing to Captain Finn's efforts the wounded lying in the more exposed positions were got into a place of greater safety.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers, in recognition of their gallantry and devotion to duty in the Field:—

AWARDED THE MILITARY CROSS.

Captain Edward Bruce Allnutt, Royal Army Medical Corps.

Temporary Lieutenant Allan Noel Minns, 39th Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty at Sulva Bay, Gallipoli Peninsula, on August 30, 1915, when attending to the wounded under heavy shrapnel fire. Another officer who was assisting him was killed. Lieutenant Minns later returned to the dressing station, took out twelve stretcher squads and brought in twenty-four wounded men.

Temporary Lieutenant Harry Bertram Walker, M.B., Royal Army Medical Corps, attached 9th Battalion, York and Lancaster Regiment.

For conspicuous gallantry and devotion to duty near Armentières on September 25, 1915. A battery was being heavily shelled, but he proceeded at once to attend to the wounded at one of the guns. While doing this the next gun was put out of action, all the detachment being killed, but he continued to attend the wounded till the arrival of the Field Ambulance.

Distinguished Conduct Medals.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-commissioned Officers and men for acts of gallantry and devotion to duty whilst serving with the Expeditionary Forces in France and Flanders, the Dardanelles, and Turkey in Asia. (*Third Supplement to the London Gazette*, No. 29252, dated August 5, 1915.)

No. 7766 Private W. R. Fitch.

For conspicuous gallantry and initiative on April 26, 1915, at Ypres. Private Fitch was marching with a column of transports which was under very heavy shell fire. The driver of a cart was shot, and the horses started to bolt, when he with great courage stopped the horses and brought the cart along, thereby averting a block and congestion of traffic, which under heavy shell fire would undoubtedly have led to great loss of life and stores.

No. 7266 Corporal J. E. McNeill.

For conspicuous gallantry on the night of May 15-16, 1915, near Rue du Bois. He repeatedly went out, and brought in wounded men under a heavy fire, and showed the greatest bravery and devotion to duty.

No. 18257 Serjeant J. Percy.

For conspicuous gallantry throughout the campaign, especially at Festubert from May 16 to 18, 1915, when he worked continuously night and day under incessant fire bringing in the wounded. Serjeant Percy has shown great resource and courage under heavy fire and has set a fine example of devotion to duty.

No. 6480 Private W. Steedman.

For conspicuous gallantry and ability on May 13, 1915, at Ypres, as Orderly to a Medical Officer. He was indefatiguable in attending to the wounded. In the heaviest fire he always went out to anyone reported wounded, and when the doctor was killed opposite a wide breach in the trench, he at once went out and removed the body. Single-handed he arranged, later on, for the removal of all the wounded during the night, and gave a splendid example of devotion to duty.

No. 11492 Serjeant K. W. Stoner.

For great bravery and consistent good work throughout the whole campaign, frequently under a very heavy fire, and notably on May 24, 1915, during the heavy fighting near Wieltje. Serjeant Stoner always showed conspicuous coolness and courage, and gave a fine example of devotion to duty.

The Director-General in recognition of the credit which these gallant actions reflect on the individuals concerned, and on the Corps, has directed that the privates shall be promoted to the rank of Corporal as vacancies occur.

His Imperial Majesty the Emperor of Russia has been graciously pleased to confer, with the approval of His Majesty The King, the undermentioned rewards for gallantry and distinguished service in the Field. (*Second Supplement to the London Gazette*, No. 29275, of August 24, 1915).

Cross of the Order of Saint George, 4th Class.

No. 12751 Serjeant T. B. Carter.
No. 11628 Serjeant T. A. Fullam.
No. 2484 Private W. A. Last.
No. 7604 Private D. Wolfe.

Medal of Saint George, 2nd Class.

No. 14077 Corporal F. M. Harris.
No. 18576 Staff-Serjeant W. Lamkin.

Medal of Saint George, 3rd Class.

No. 9939 Corporal A. Burns.
No. 7766 Private W. R. Fitch.
No. 6805 Private B. P. Thorpe.

Medal of Saint George, 4th Class.

No. 7695 Private T. Emmerson.
No. 3311 Private W. Hanson.
No. 1249 Private T. Markes.
No. 20852 Private H. Wilkinson.

ARMY MEDICAL SERVICE.

Colonel Henry O. Trevor, on completion of four years' service in his rank, is retained on the Active List, under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be supernumerary, dated October 26, 1915.

The undermentioned Lieutenant-Colonels to be temporary Colonels whilst holding the appointments of Assistant Directors of Medical Services :—

Dated July 23, 1915.—Alfred E. C. Keble.
Dated August 18, 1915.—George S. McLoughlin, C.M.G., D.S.O.
Dated August 19, 1915.—John D. Ferguson, D.S.O.
Dated August 22, 1915.—Henry N. Dunn.
Dated September 8, 1915.—Edward W. Slayter.
Dated September 13, 1915.—Nicholas Tyacke.
Dated September 22, 1915.—Harry A. Hinge.

ROYAL ARMY MEDICAL CORPS.

Dated August 8, 1915.—Major Alexander M. McIntosh, M.B., to be temporary Lieutenant-Colonel while acting as Assistant-Director of Medical Services, Lowland Division.

Dated October 1, 1915.—Reginald Anstruther Farrar, M.D., to be temporary Major.

Dated October 4, 1915.—Major Francis S. Irvine, M.B., to be temporary Lieutenant-Colonel whilst Commandant of the Training Establishment.

Dated October, 9, 1915.—Surgeon Captain George S. C. Hayes, Reserve of Officers, to be temporary Major whilst in command of a Field Ambulance.

Dated October 20, 1915.—Major Thomas Mackenzie, M.D., The King's (Liverpool Regiment), Territorial Force, to be temporary Major.

Dated October 26, 1915.—Captain William F. Christie is granted the local rank of Major whilst serving as Senior Medical Officer at the Straits Settlements.

Dated October 27, 1915.—Temporary Major George E. Miles, to be temporary Lieutenant-Colonel.

Dated October 29, 1915.—Captain Robert E. Kelly, M.D., F.R.C.S., Royal Army Medical Corps, Territorial Force, to be temporary Major.

Dated October 30, 1915.—Temporary Lieutenant Robert Tait McKenzie, M.D., to be temporary Major.

Dated November 4, 1915.—Temporary Major J. F. W. Silk, M.D., to be temporary Lieutenant-Colonel.

The undermentioned to be temporary Captains :—

Dated October 1, 1915.—William Mervyn Crofton, M.D.
Dated October 4, 1915.—Benjamin Holroyd Slater, M.B., F.R.C.S.
Dated October 7, 1915.—George Davison Laing, M.D. ; Harold Upcott, F.R.C.S.

The undermentioned temporary Lieutenants to be temporary Captains :—

Dated August 9, 1915,—Edwin J. Wyler, M.D.
Dated September 9, 1915.—Nigel P. Boulton, M.B.
Dated September 16, 1915.—Stanley P. Stoker, M.B.; Oliver C. Link, M.B. ; Ernest E. Holden.
Dated September 17, 1915.—William C. Horton, M.B., F.R.C.S.Edin.
Dated September 18, 1915.—James Wilson, M.B., F.R.C.S.Edin.
Dated September 21, 1915.—William H. Sutcliffe, M.B. ; Roy W. Russell-Jones, M.B. ; Trevor H. Wilkins.
Dated September 22, 1915.—Daniel J. Mulholland, M.D. ; Reginald B. Heygate ; Reginald C. Verley, M.B.

Dated September 23, 1915.—Percy Gully; George D'R. Carr.
Dated September 26, 1915.—David H. Hadden, M.B.
Dated October 30, 1915.—Joseph Alan Longley, M.B., F.R.C.S.Edin.
Temporary Honorary Captain Walter Seymour Armstrong, from the Australian Voluntary Hospital, to be temporary Captain, dated October 15, 1915.
William Martin Flack, M.B., is granted temporarily the honorary rank of Captain, dated October 21, 1915.
The undermentioned temporary Honorary Lieutenants to be temporary Honorary Captains whilst serving with No. 1 British Red Cross (Duchess of Westminster's) Hospital:—
Dated October 15, 1915.—J. S. Burn, D. M. Stone, J. Erlank.
Captain Robert G. Archibald, M.B., from the seconded list, is restored to the Establishment, dated October 5, 1915.
The undermentioned to be temporary Lieutenants:—
Dated June 24, 1915.—David Eardley Fenwick, M.B.
Dated July 5, 1915.—Donald Meek, M.B.
Dated August 12, 1915.—James Boyd, F.R.C.S.Edin.
Dated August 19, 1915.—Arthur Leonard Anderson.
Dated August 21, 1915.—Clifton Eric Tucker, M.B.
Dated August 24, 1915.—Hugh Frederic Wickens, M.B.
Dated August 26, 1915.—James Charles Donaldson Simpson, M.B.
Dated August 29, 1915.—Geoffrey Alden Barss, M.D.
Dated September 21, 1915.—Gordon Stuart Terry.
Dated September 27, 1915.—Mark Basil Lindsey.
Dated September 30, 1915.—Michael Gilbert Dobbyn, F.R.C.S.I.
Dated October 1, 1915.—Herbert Melville Green, M.D.; Samuel Shuttleworth Rendall, M.B.; Allen Bathurst Brown; George Dewar, M.B.; James Todd, M.D.; Andrew Cassels Brown, M.D.; David Robertson MacGregor, M.B.; Edward Augustus Bullmore, F.R.C.S.Edin.; Alan Edward Staffurth; Sydney Walter Fisher, M.B.; Wilfred Wood Wells, M.B.; John Braybrook Binns; Walter Colquhoun, M.B.; George Reid Hannon; David Davey Rosewarne; Henry Cross; William Ernest Amsden Worley; Nicholas Elrington; John Burke; Gordon Dill Latimer, M.B.; Richard Harris Oliver, F.R.C.S.I.; Clement Woodthorpe Chaplin, M.D.; Walter Osborne Arnold, M.B.; John Elliott; William Rolland, M.D.; Arthur Thompson; John William Burns, M.D.; Michael William Robertson, M.B.; John Edward Prentis; Arthur Ernest William Idris; John Braithwaite, M.B.; Hugh Davies-Colley, F.R.C.S.; Hubert Shearwood Roberts, M.D.; Alfred Edward Stevens, M.D.; John Ferguson, M.B.; Samuel Alexander, M.D.; James Brereton-Barry; James Thompson Carson, M.B.; Hugh Paul Helsham; Alfred Dorriforth Vardon; Francis William Mason; William Edward Sawers Scott, M.D.; Edward McCulloch, M.B. Edmund Howard Barrett, M.B.; John Davidson Smith, M.B.; Thomas Blandford Watson, M.B.; Walter Sidney Hart, M.B.; Neil Keith, M.B.; John Healey, M.B.; St. George Eyre Harris, M.D.; John Charles King; James McIlraith, M.D.; Thomas Walmsley Heywood; Henry Edward Jones, M.B.; Lionel Lewis Phillips; Edgar Baldwin; Edward James Tyrrell, M.D.; Henry Chisholm Will; Leonard Augustus Moore, M.B.; Edgar Arthur Shirvell; George Edward Stephenson, M.B.; Cornelius Thompson, M.B.; Thomas Goodsall Copestake, M.B.; John Maundy Biggs; Thomas Forsyth, M.B.; Hillyard William Haydon, M.D.; Reginald Anthony Eastmond, M.B.; William Gardiner McConnell; William Craig, M.B.; Gwilym Ambrose Williams; Charles Marshall Stallard, M.B.; Daniel Wright Ritchie, M.B.; Alfred Griffiths, M.B., F.R.C.S.Edin.; Charles Edward Percival Husband, M.B.; Sidney Herbert Longhurst; Edward Lanigan; Frank Briggs Cullen.
Dated October 2, 1915.—William James Rutherford, M.D.
Dated October 4, 1915.—Arthur Gerard Cheyne Irvine; Alexander Girvan, M.D. F.R.C.S.Edin.; Kingsley Chisman Pitman; Alfred Hamilton Rentoul, M.D.; Francis Dugon; Reginald Prynne Marshall; Idwal Wynne Jones, M.B.; Andrew Fergus Hewat, M.B.; William Shipton, M.B.; Thomas Woodman, M.D.; Cecil John Marsh; Frederick Leonard Sessions; Oswald Pitt; Ian Maclean Frazer, M.B.
Dated October 5, 1915.—Thomas Edmund Dobbs; Alexander Murray Drenham, M.B.; James Templeton; Alfred Darlow; Norman Macphail, M.B.; Roger Michael Wright, M.B.; Robert Svensson, M.B.
Dated October 6, 1915.—Henry Deedes Nutt MacKenzie, M.D.
Dated October 7, 1915.—Gordon Stonehouse; Henry Richmond, M.B.; Martin Turnbull, M.B.; John Hyde Iles, M.B.; William Landsborough, M.B.; Hugh Barr,

M.B.; Thomas Burns Dakin; William Forsyth Gibb; Hugh Cecil Addison; James Huntley Legge, M.B.; George MacKenzie Miller, M.B.; Thomas Bolster Newman; Wilson Astin, M.B.; William Elliot Randal Dimond; William Hardy Fleetwood; Harry Mewburn Brown, M.B.; Esmond Tetley Willans; Lionel Page; David Thomas Price, M.B.; Archibald Naismith, M.B.; John Wilson Miller, M.B.; George Clement Neilson, M.B.; Ronald Dingwall Hodge, M.B.; William Hamilton, M.B.; Frederick Crampton Merrall, M.B.; Andrew Muir, M.B.: Thomas MacHardy, M.B.; William Frank Lydstone Day, M.B.; John Allan Robertson Wells; Robert Dick Buchanan, M.D.; William Linnel Partridge; Thomas Hall Gandy, M.B.; Henry Carson Smyth; Robert Chichester McMillan, M.B.; George Bertrand Lucas; Hanley Alison; Edward Laurence Pilbean.

Dated October 8, 1915.—Sidney Smallbroke Depree, M.B.

Dated October 10, 1915.—John Colley Pounden, M.D.

Dated October 12, 1915.—Frederick Charles Tucker.

Dated October 13, 1915.—Ronald William Carmichael; John Arnold Jones, M.B., F.R.C.S.Edin.; George Henderson, M.B.; Francis Joseph Morrin, M.B.

Dated October 14, 1915.—Harold Douglas Wyatt; Alfred Clarence Norman, M.D.; Francis Reinagle Barwell; Bernard Edward Augustine Batt, M.B.; Coram LLewellyn Stuart James; Francis James Alphonsus Keane, M.D.; Reginald Woolsey Stocks; Eber Caudwell; Robert Frew, M.B.; Frederick Alexander Anderson, M.B.; Herbert Mitchell, M.B.; William Fothergill Wilson, M.B.; William Lockhead Scott, M.D.; Godfrey Bateman, M.B.; William Edward Coulson Musson.

Dated October 15, 1915.—William Joseph Greehy.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated October 14, 1915.—Gervase Charles Wells-Cole; Gordon Doulton East; Harold James Bower.

Dated October 18, 1915.—Walter Francis Moore, M.D.

The notifications regarding the undermentioned temporary Lieutenants, which appeared in the *Gazettes* of September 20, 1915, and October 5, 1915, respectively, are cancelled:—

John I. Johnson.

Clark McKerrow.

Lieutenant James Clark McKerrow, M.B., from the Prince of Wales's Volunteers (South Lancashire Regiment), Special Reserve, to be temporary Lieutenant, dated June 24, 1915 (substituted for the notification which appeared in the *Gazette* of July 13, 1915).

Temporary Second Lieutenant Cornelius Hermanus Hubertus Coetzee, M.B., from Royal Field Artillery, dated October 10, 1915.

The appointment to a temporary Lieutenancy of Fraser B. Gurd, M.B., is antedated to May 25, 1915.

The name of temporary Lieutenant Arthur Lowry Robinson is as now described, and not as stated in the *Gazette* of October 14, 1915.

The undermentioned to be temporary Honorary Lieutenants:—

Dated July 30, 1915.—Gerald Struan Marshall.

Dated October 13, 1915.—Geoffrey Marr Vevers.

Dated October 18, 1915.—Eric Gordon Baker; George William Huggins; Francis Keene Marriott; Gerald Evan Spicer.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated September 19, 1915.—Ralph G. Dainty.

Dated September 21, 1916.—Leslie H. Skene, M.B.

Temporary Lieutenant George Fox relinquishes his commission on account of ill-health, dated October 19, 1915.

Temporary Captain Lewis E. Barnett, M.B., F.R.C.S., relinquishes his commision on transfer to the New Zealand Medical Corps, dated October 8, 1915.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Edward John Harris, dated October 4, 1915.

Harry Humphrey Taylor, dated October 12, 1915.

Frederick Richardson, dated October 12, 1915.

John William Mayne, dated October 18, 1915

WARRANT OFFICERS, NON-COMMISSIONED OFFICERS, AND MEN.

The following promotions to complete War Establishment, will take effect from the dates specified :—

To be Serjeant-Majors.

No.	Rank and Name		Date	Remarks
8288	Qmr.-Serjt.	Andrews, M.	5.6.15	With seniority next below No. 8287 Serjeant-Major W. E. Maitland.

To be Quartermaster-Serjeants.

103	Staff-Serjt.	Steer, G. P.	27.7.15	
10360	,,	Toms, C. J.	31.7.15	
10638	,,	George, F.	4.8.15	
12065	,,	McKnight, A. A. E. ..	,,	
10003	,,	Elmer, H.	21.8.15	
10936	,,	Lake, H. T.	6.9.15	
1962	,,	Canty, A. J.	,,	
12535	,,	Oliver, T. E.	16.9.15	
16301	,,	Lane, E. A.	,,	

To be Staff-Serjeants.

19272	Serjeant	Lee, W. J.	27.7.15	
19303	,,	Green, R. T.	,,	
1848	,,	Martins, A. V. ..	31.7.15	
19863	,,	Mattison, W. H. ..	,,	
2147	,,	Hampson, W. C. ..	4.8.15	
4882	,,	Summers, F. G. ..	,,	
18675	,,	Partridge, A. C. ..	,,	
1094	,,	Alloway, H. B. ..	,,	
10887	,,	Humphrey, W. A. ..	21.8.15	
1097	,,	Herbert, R.	,,	
19530	,,	Reece, W. E.	27·8·15	
17889	,,	Dyke, W. E.	,,	
1305	,,	Prince, H. M... ..	6.9.15	Special for valuable service in France 18 R.A.M.C. 790, A.M.D.1. Dated 3.9.15.
17102	,,	Harvey, D.	,,	
17553	,,	Morfitt, J. R.	16.9.15	
15022	,,	Woodward, F. ..	,,	

To be Serjeants.

997	Corporal	Corbett, T. F	14.7.15	
18979	,,	Bushnell, S. R. ..	27.7.15	As being in possession of A.F. C. 344.
5260	,,	Bew, A. J.	,,	
18666	,,	Janes, J.	31.7.15	
18734	,,	Wilson, S.	,,	
20007	,,	Oliver, G.	4.8.15	
20708	,,	Smith, W.	,,	
20504	,,	Aitchison, J. W. ..	,,	
20145	,,	Davies, H. G... ..	,,	
18908	,,	Dart, W. H.	13.8.15	
18921	,,	Doling, W. H. ..	21.8.15	
17820	,,	Peckham, H.	,,	
1509	,,	Warren, A.	27.8.15	Special as clerk.
2221	,,	Coleman, G.	,,	
5235	,,	Botten, G. H... ..	6.9.15	
6954	,,	Fallaize, W. E. ..	,,	Special as drill instructor.
408	,,	Kniep, O.	16.9.15	
19031	,,	Leahy, J.	,,	

To be Corporals.

No.	Rank	Name	Date	Remarks
11026	Private	Bennett, B.	27.7.15	In accordance with Corps Order No. 71 of this date.
7611	,,	Kerry, W.	,,	
4039	,,	Clements, T. A. ..	,,	
5711	,,	Chester, J.	31.7.15	
6067	,,	Flynn, T. J.	,,	
6107	,,	Deacon, J.	4.8.15	
20527	,,	Totty, G.	,,	
20048	,,	Walker, G.	,,	
20483	,,	Weate, J.	,,	
20164	,,	Shaw, H.	,,	
412	,,	Cunnington, S. ..	10.8.15	
6840	,,	Steedman, W. ..	13.8.15	
7766	,,	Fitch, W. R.	21.8.15	
534	,,	Allan, H. J.	,,	
513	,,	Robbins, W. H. ..	,,	
6115	,,	Manchip, E. J. ..	26.8.15	
6129	,,	McDermott, J. ..	27.8.15	
6285	,,	Powell, E.	,,	
6305	,,	Goswell, A. W. ..	5.9.15	
6390	,,	Wyatt, P.	6.9.15	
6495	,,	Bennett, W. H. ..	,,	
6568	,,	Casey, L.	,,	
19859	,,	Hicks, L. A.	16.9.15	
6350	,,	Hewson, E.	,,	
6802	,,	Ball, A. C.	,,	
6812	,,	Musgrave, R. C. ..	,,	

These promotions are subject to the conditions laid down in paragraph 35, Standing Orders, R.A.M.C., 1914.

AWARD OF ARMY FORM C. 344.

The undermentioned have been awarded Army Form C. 344 on completion of three years' training in accordance with paragraph 330, Standing Orders, on the dates specified :—

No	Rank	Name	Date	Remarks
1973	Corporal	Elliott, W.	20.3.15	
4936	,,	Strange, H. E. ..	,,	
5106	,,	Clarke, A. E.	,,	
5200	Private	Breeze, J. H.	29.7.15	
1797	,,	Mudge, W.	,,	
5097	,,	Woodfield, J. H. ..	,,	
6103	Corporal	Allen, W. G.	7.8.15	
5866	Private	Toms, F. H.	,,	
2150	Corporal	Fraser, E. G... ..	,,	

NURSING SECTION.

The following appointments to the Nursing Section of the Corps will take effect from the dates specified :—

No.	Rank and Name		Date	Remarks
7904	Private	Bray, T.	26.7.15	
6363	,,	Herbert, L. M. ..	,,	
7620	,,	Kirkwood, G.	,,	
5090	,,	Hayward, R.	4.8.15	
527	,,	Graham, A.	,,	
7459	,,	Dundas, A. D. ..	,,	
10705	,,	Megeary, L.	,,	
7637	,,	Dexter, J. T.	,,	
18334	,,	Barclay, A.	,,	
5344	,,	Busson, T.	,,	
2268	,,	Danks, T.	,,	
5265	,,	Flook, R. J.	,,	
15392	,,	Slater, J.	,,	
5138	,,	Ransome, D.	,,	Reappointed.
5842	,,	Moore, J. F.	9.8.15	
5375	,,	Barwick, J. H. ..	11.8.15	
5258	,,	Dring, B. C.	13.8.15	
6155	,,	Sewell, P.	,,	Reappointed.
19902	,,	Crampton, R. T. ..	,,	,,
16040	,,	Hammond, M. J. ..	14.8.15	
10028	,,	Hodge, T.	,,	
10587	,,	Marshallsay, G. ..	,,	
10714	,,	Rhodes, T.	,,	
10674	,,	Stoker, H.	,,	
7812	,,	Thorpe, G. W. ..	,,	
7689	,,	Baylis, A. E.	16.8.15	
17969	,,	Newman, B.	,,	
2814	,,	Rawlings, A.	,,	
2883	,,	Vick, W.	,,	
18896	,,	Hunter, D.	,,	
7691	,,	Chaplow, T.	,,	
17689	,,	Copley, A.	,,	
10647	,,	Bond, F. W.	,,	
16504	,,	McCrory, H.	,,	
35	,,	Gerathy, A.	,,	
17956	,,	Purdue, P.	,,	
19816	,,	Hall, P.	,,	
6450	,,	Evans, J. H.	,,	
6082	,,	Forrester, W.	17.8.15	
7597	,,	Holmes, W. S. ..	,,	
7698	,,	Smith, H. J.	,,	
4749	,,	Headdock, C.	19.8.15	
20649	,,	Sims, E. J.	23.8.15	
20234	,,	Morgan, A.	,,	
20531	,,	Morgan, W.	,,	
20082	,,	Miller, J.	,,	
20616	,,	Holway, A.	,,	
20632	,,	Gibbon, A. H... ..	,,	
18267	,,	Lyon, J. O.	,,	Reappointed.
6983	,,	Lloyd, F. F.	,,	
6024	,,	Tuddenham, S. G. ..	25.8.15	Reappointed.
10062	,,	Helm, A.	27.8.15	

Nursing Section—Continued.

No.	Rank and Name		Date	Remarks
10355	Private	Larkin, T.	27.8.15	
10489	,,	Meadley, W.	,,	
10097	,,	Micheal, J.	,,	
1557	,,	Newman, J.	,,	
10358	,,	Penn, T.	,,	
2291	,,	Quigley, A.	,,	
10387	,,	Tunstall, W.	,,	
1821	,,	Turney, E.	,,	
5094	,,	Wilson, G.	,,	
10234	,,	Whitaker, R.	,,	
6837	,,	Starns, W. A... ..	1.9.15	
7675	,,	Hughes, E.	,,	
18901	,,	Milford, T.	,,	
7206	,,	Soden, V.	,,	
5872	,,	Carleton, T.	,,	
18680	,,	Murphy, T.	,,	
7666	,,	Holme, W.	,,	
7729	,,	Hobbs, F.	,,	
2486	,,	Chubb, E. L. W. ..	,,	
1471	,,	Cove, E. A.	,,	
13214	,,	Kenway, C.	,,	
10174	,,	Stockbridge, T. R. ..	,,	
10706	,,	Mitchell, A.	2.9.15	
5379	,,	Harvey, F.	,,	
7045	,,	Jones, L.	,,	
4021	,,	Shale, J.	,,	
5460	,,	Gee, H. J. R.	3.9.15	
19717	,,	Collins, H.	,,	
4354	,,	Bowman, A.	,,	
7625	,,	Stallard, W. G. P. ..	,,	
10481	,,	Hiscock, H. J. ..	,,	
6653	,,	Jones, M.	7.9.15	
5065	,,	Robins, F. J.	,,	
4509	,,	Simmons, N. H. ..	,,	
4501	,,	Smithson, E... ..	,,	
7470	,,	Neale, H.	,,	
7273	,,	Baxter, H.	9.9.15	
5660	,,	Laurent, F. C. ..	,,	
475	,,	McQueen, J.	,,	
2047	,,	Nesbitt, W.	,,	
2038	,,	Neville, M.	,,	
18476	,,	Rodwell, F. G. ..	,,	
2537	,,	Gray, E. P.	11.9.15	
5004	,,	Grey, C.	,,	
4460	,,	Saunders, A. A. ..	,,	
1067	,,	Laversuch, R. L. ..	13.9.15	
5812	,,	Duncan, J.	,,	
10035	,,	Ingram, S. J.	,,	
20345	,,	Richards, S. R. ..	,,	

ADVANCEMENT OF PRIVATES (CORPS PAY).

The following advancements in rate of Corps Pay will take effect from September 18, 1915 :—

To be advanced to the Third Rate (at 8d.).

As Orderlies.

No.	Name	No.	Name	No.	Name
19642	Dale, J. C.	19661	Gill, E.	6421	Page, J. R.
4470	King, A.	4940	Holway, A. L.	6108	Houghton, A.
19421	Pegler, J.	1832	Judd, H.	18967	Smith, W.
14904	Bonser, G. W.	6378	Miles, F. E.	4393	Hargrave, T. B.
380	Hort, L. J.	5881	Moth, J. C.	16506	Lark, C.
6826	Morgan, A. W.	1679	Gray, A.	18472	Waller, G.
2084	Titchener, F. S.	17178	Ingmire, G. A.	17564	White, W. H.
2222	Baker, W. H.	5006	Cronley, A. C.		
19959	Gale, F. W.	5361	Orr, R.		

To be advanced to the Fourth Rate (at 6d.).

As Orderlies.

7237	Varnals, J.	14901	Smith, J. W. H.	10489	Meadley, W.
20559	Sims, E.	18056	Yates, E.	10097	Michael, J.
20106	Worrall, A.	1859	Green, W. R.	10358	Penn, T.
20499	Fisher, A. A.	6384	Hill, W.	2291	Quigley, A.
20278	Webster, F.	19487	Devall, E.	10387	Tunstall, W.
20062	Thacker, B. H.	19868	Harris, A. E.	1821	Turney, E.
20301	Flackett, L.	19797	Hughes, A. J.	10234	Whitaker, R.
7609	Gillingham, H. St.H.	5848	Kay, J.	5532	Lawrence, F. E.
		7346	Armstrong, W. L.	7441	Cousins, A. E.
982	Mathewson, T. S.	309	Turner, A. J.	6000	Quantrill, J. S.
1572	Butterwick, W.	5842	Moore, J. F.	7071	Taylor, B.
10705	Megeary, L.	8271	Greengrass, B. J.	6803	Lee, W.
19999	Dodds, D.	8760	McFarlane, J.	2960	Tittley, F.
18543	Lawson, J.	7707	Sheppard, E. E.	6814	Jones, H.
14388	Astley, J.	7422	Butler, F. W.	4786	Squires, R. T.
17407	Howard, H.	6244	Dewey, R. J.	8440	Whyman, R.
256	Rains, J. W.	10062	Helm, A.	5066	Brown, T.
18055	Rushworth, N.	10355	Larkin, T.	7242	Potter, S. J.

To be advanced to the Third Rate (at 8d).

As Clerks.

18125	Dickinson, L. C.

To be advanced to the Fourth Rate (at 6d).

As Clerks.

10466	Rowley, L. R.	6197	Whelan, M.	4553	Davies, R. W.
6616	Brain, W. T.	10447	Fairlie, E.	6925	Smith, F. W.
7274	Macrow, B. T.	8443	Herrick, W. T.		

As Cooks.

5276	Oakley, A. S.	10526	Peachey, A. W.	4759	Peters, R. A.
1544	Farrow, J.	2339	Marston, E.	5757	McSweeney, W.
3640	MacDonald, W.	2377	Allder, W.	1454	Headington, A.

These advancements are subject to the conditions laid down in paragraph 35 Standing Orders for the Royal Army Medical Corps.

RE-POSTING TO CORPS.

The undermentioned N.C.O.'s rejoined the Corps on the dates specified:—

No. 15312 Staff-Serjeant G. Gillespie, August 2, 1915, from Colonial Government.

No. 19478 Serjeant A. Pollitt, August 2, 1915, from Colonial Government.

No. 10003 Staff-Serjeant H. Elmer, August 7, 1915, from Territorial Force.

No. 10710 Quartermaster-Serjeant J. Moore, August 15, 1915, from Colonial Government.

AMENDMENTS—CORPS ORDERS.

In Corps Order dated July 28, 1915, the Corps number of Corporal J. Knight, promoted to be Serjeant, should read 18417 and not 18714.

PROMOTION CANCELLED.

The promotion to the rank of Serjeant, notified in Corps Order dated June 21, 1915, of No. 17787 Corporal A. H. Whyatt, is hereby cancelled.

TERRITORIAL FORCE.

ROYAL ARMY MEDICAL CORPS.

1st London Casualty Clearing Station.—Lieutenant Alexander Urquhart, M.D., to be Captain, dated September 25, 1915.

1st London Sanitary Company.—The undermentioned Lieutenants to be Captains: Lionel W. Hignett, M.B., dated August 23, 1915; Henry Holroyd, M.B., dated September 15, 1915; Daniel M. Taylor, M.D., dated September 29, 1915; Charles J. D. Gair, and to remain seconded, dated June 19, 1915.

2nd London (City of London) General Hospital.—Major Theodore D. Acland, M.D., is seconded, dated October 16, 1915; Ernest Cranmer Hughes, F.R.C.S., to be Captain, whose services will be available on mobilization, dated October 31, 1915.

2nd London Field Ambulance.—Lieutenant Charles E. Williams to be Captain, dated September 19, 1915.

2nd London Sanitary Company.—Lieutenant Herbert Beeney to be Captain, dated October 6, 1915; William Hugh Hill, M.D., to be Lieutenant, dated October 11, 1915.

3rd London Field Ambulance.—The undermentioned Lieutenants to be Captains: George W. Greene, M.D.; dated September 11, 1915; Alfred N. G. Jeans, dated September 27, 1915.

3rd London General Hospital.—Lieutenant George Finch to be Captain, dated April 1, 1915.

4th London Field Ambulance.—The date of promotion of Lieutenant John A. Watt, M.B., to Captain is April 1, 1915, and not as stated in the *London Gazette* of September 17, 1915; Lieutenant Alfred R. Spencer, M.D., to be Captain, dated April 23, 1915.

5th London General Hospital.—Philip Geoffrey Doyne to be Lieutenant, dated August 16, 1915; Serjeant-Major Albert Arthur Lippold, from the 2nd London (City of London) General Hospital, to be Quartermaster, with the honorary rank of Lieutenant, dated October 23, 1915.

Scottish Horse Mounted Brigade Field Ambulance.—Lieutenant John E. Lascelles to be Captain, dated June 10, 1915.

1st Scottish General Hospital.—The undermentioned Lieutenants to be Captains, dated October 1, 1915: Herbert J. A. Longmore, M.B.; Douglas W. Berry, M.B.; Cameron M. Nicol, M.B.

3rd Highland Field Ambulance.—Lieutenant Douglas H. Scott, M.B., to be Captain, dated April 1, 1915; Charles Gunn Skinner to be Lieutenant, dated August 25, 1915.

Lowland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains: John R. Herbertson, M.B., dated September 30, 1915; Stuart S. Meighan, M.B., dated September 30, 1915; Thomas C. Houston, M.B., dated October 2, 1915.

Lowland Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Adam Rankine, M.B., dated June 30, 1915; Stuart Robertson, M.B., dated June 30, 1915; Lieutenant Stephen A. MacPhee, M.B., to be Captain, dated July 9, 1915.

1*st Lowland Field Ambulance.*—Robert Armstrong, M.B., to be Lieutenant, dated October 11, 1915.

2*nd Lowland Field Ambulance.*—Lieutenant William Grove, M.B., relinquishes his commission on account of ill-health, dated October 21, 1915.

2*nd Northumbrian Field Ambulance.*—Lieutenant John P. Race to be Captain, dated September 22, 1915; Major John A. Kendall, M.D., from Attached to Units other than Medical Units, to be Major, dated October 17, 1915; Captain Clifford C. Pickles relinquishes his commission on account of ill-health, dated October 21, 1915.

3*rd Northumbrian Field Ambulance.*—Julius Barnett Sinson, M.B., to be Lieutenant, dated September 18, 1915.

North Midland Mounted Brigade Field Ambulance.—The date of appointment of Lieutenant James Mitchell Mitchell, M.B., is August 17, 1915, and not as stated in the *London Gazette* of September 20, 1915.

North Midland Casualty Clearing Station.—Lieutenant Henry C. Bevan, to be Captain, dated September 23, 1915.

1*st North Midland Field Ambulance.*—Thomas Edmund Ashdown Carr, M.B. (late temporary Lieutenant, Royal Army Medical Corps), to be Lieutenant, dated September 17, 1915.

2*nd North Midland Field Ambulance.*—Captain Alfred C. F. Turner, M.B., to be temporary Major, dated August 20, 1915.

3*rd North Midland Field Ambulance.*—Lieutenant Arthur E. Tait, M.B., from 2nd East Anglian Field Ambulance, to be Lieutenant, dated October 23, 1915.

South Midland Casualty Clearing Station.—The date of appointment of Lieutenant Astley B. Prosser, M.B., is April 27, 1915, and not as stated in the *London Gazette* of May 17, 1915. Lieutenant William A. Higgins, M.D., resigns his commission on on account of ill-health, dated October 24, 1915.

1*st South Midland Mounted Brigade Field Ambulance.*—Arthur Charles Oakley Brown, to be Lieutenant, dated October 4, 1915.

1*st South Midland Field Ambulance.*—The announcement of the seconding of Quartermaster and Honorary Captain William H. Kimpton which appeared in the *London Gazette* of August 13, 1915, is cancelled.

2*nd South Midland Field Ambulance.*—Captain Kenneth D. Wilkinson, M.B., from Attached to Units other than Medical Units, to be Captain, dated April 1, 1915.

East Lancashire Casualty Clearing Station.—Captain Charles H. Crawshaw, M.B., from 2nd Western General Hospital, to be Captain, dated October 24, 1915; Captain Thomas P. Kilner, M.B., from 2nd Western General Hospital, to be Captain, dated October 24, 1915; Lieutenant Edward A. Williams, from 2nd Western General Hospital, to be Captain, dated October 24, 1915.

1*st East Lancashire Field Ambulance.*—Lieutenant William L. Cockcroft, to be Captain, dated July 26, 1915. Quartermaster and Honorary Lieutenant Sydney Workman is seconded for duty with an Infantry Base Depôt, dated October 16, 1915.

2*nd East Lancashire Field Ambulance.*—Lieutenant Emor R. Cooper, M.B., to be Captain, dated May 25, 1915; Lieutenant William Clegg-Newton, to be Captain, dated September 10, 1915.

3*rd East Lancashire Field Ambulance.*—Lieutenant Frank K. Tomlinson, M.B., to be Captain, dated April 1, 1915; Lieutenant William Calverley, M.B., to be Captain, dated September 20, 1915; Lieutenant James Cowan, to be Captain, dated June 3, 1915. The date of promotion of Lieutenant Frank G. Prestwich is May 24, 1915, and not as stated in the *London Gazette* of October, 1, 1915.

West Lancashire Casualty Clearing Station.—The undermentioned' Lieutenants to be Captains: William P. Moffet, M.B., dated May 28, 1915; Harry D. Levick, M.B., F.R.C.S, dated July 10, 1915.

1st West Lancashire Field Ambulance.—Major Creighton H. Lindsay, M.D., to be temporary Lieutenant-Colonel, dated August 24, 1915; Serjeant-Major William Hamilton Bell, to be Quartermaster, with the honorary rank of Lieutenant, dated October 30, 1915.

2nd West Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: Sydney Sharples, dated April 1, 1915; Joseph H. Mather, dated July 1, 1915; Leonard S. Gaskell, M.B., dated June 1, 1915; Serjeant-Major George William Hamilton, to be Quartermaster, with the honorary rank of Lieutenant, dated September 1, 1915.

3rd West Lancashire Field Ambulance.—Lieutenant Francis S. Fletcher, M.B., to be Captain, dated April 1, 1915; Captain George B. Robinson, M.D., from Attached to Units other than Medical Units, to be Captain, dated October 1, 1915; Serjeant Richard Gordon Ithell, from the 1st West Lancashire Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated October 30, 1915.

1st South Western Mounted Brigade Field Ambulance.—Lieutenant William A. Milner to be Captain, dated October 10, 1915.

South Wales Mounted Brigade Field Ambulance.—James Ernest Dunbar, M.B., to be Lieutenant, dated September 24, 1915.

2nd Welsh Field Ambulance.—Lieutenant David T. Lewis to be Captain, dated July 7, 1915.

1st Northern General Hospital.—The undermentioned Lieutenants to be Captains, dated October 1, 1915: Sydney Havelock, M.B.; Charles H. Keay, M.B.

3rd Northern General Hospital.—Lieutenant George E. Martin, M.B., to be Captain, dated July 1, 1915.

2nd East Anglian Field Ambulance.—Lieutenant James Simson, M.B., to be Captain, dated April 1, 1915.

3rd East Anglian Field Ambulance.—The date of appointment of Lieutenant Roy D. Langdale-Kelham is August 20, 1915, and not as stated in the *London Gazette* of October 1, 1915.

West Riding Casualty Clearing Station.—Lieutenant Peter McEwan, M.B., F.R.C.S.Edin., to be Captain, dated October 12, 1915.

1st West Riding Field Ambulance.—Major Walter Lister to be temporary Lieutenant-Colonel, dated October, 1915; Captain Harry B. Sproat, M.D., to be temporary Major, dated October 1915.

2nd West Riding Field Ambulance.—Major Charles W. Eames, M.D., to be temporary Lieutenant-Colonel, dated September 17, 1915.

3rd West Riding Field Ambulance.—Major James Mackinnon to be temporary Lieutenant-Colonel, dated September 18, 1915.

South Eastern Mounted Brigade Field Ambulance.—William Williamson Kerr Duncan to be Lieutenant, dated September 25, 1915.

2nd Eastern General Hospital.—Lieutenant-Colonel Edward F. Maynard, M.D., is restored to the Establishment, dated October 21, 1915.

Wessex Casualty Clearing Station.—Paul McKenna Terry (late Major, 1st Wessex Brigade, Royal Field Artillery) to be Major, dated October 6, 1915.

2nd Wessex Field Ambulance.—Lieutenant Ernest H. Scholefield, M.B., to be Captain, dated October 14, 1915; Captain William Blackwood, M.B., to be temporary Major, dated October 23, 1915.

1st Western General Hospital.—Lieutenant Ralph Lamb to be Captain, dated May 23, 1915; Lieutenant Charles P. Brentnall to be Captain, dated October 1, 1915.

1st Southern General Hospital.—David Rutherford Dow, M.B., to be Lieutenant, dated October 8, 1915.

2nd Home Counties Field Ambulance.—Lieutenant Ernest M. Morris to be Captain, dated April 1, 1915; Captain William E. Alston, M.D., to be temporary Major, dated September 12, 1915.

3rd Home Counties Field Ambulance.—Major James Barkley to be temporary Lieutenant-Colonel, dated August 11, 1915; Lieutenant (temporary Captain) Charles Killick, M.D., F.R.C.S., to be Captain, dated April 1, 1915; Lieutenant Horace T. N. Merrick, M.B., to be Captain, dated April 1, 1915.

SPECIAL RESERVE.

Royal Army Medical Corps.

Lieutenant David Mackie to be Captain, dated April 1, 1915, with seniority next below J. Taylor (substituted for the notification which appeared in the *Gazette* of July 26, 1915).

Lieutenant (on probation) Alexander L. Mackenzie, M.B., is confirmed in his rank.

Attached to Units other than Medical Units.

Lieutenant William D. Frew to be Captain, dated April 1, 1915.
Lieutenant Dugald C. Bremner, M.B., to be Captain, dated April 1, 1915.
Lieutenant Joseph S. Townley, M.B., to be Captain, dated April 1, 1915.
Lieutenant Norman G. H. Salmon, M.B., to be Captain, dated April 1, 1915.
Lieutenant Charles G. Brentnall, M.B., to be Captain, dated April 1, 1915.
Lieutenant Lewis C. Bruce, M.D., to be Captain, dated April 1, 1915.
The date of promotion of Lieutenant Ernest B. Keen to Captain is April 1, 1915, and not as stated in the *London Gazette* of August 26, 1915.
Lieutenant Harold F. Comyn, M.B. to be Captain, dated April 24, 1915.
Lieutenant Wilfrid A. L. Jackson, M.B., to be Captain, dated April 26, 1915.
Lieutenant David E. Evans to be Captain, dated May 10, 1915.
Lieutenant Samuel Shepheard to be Captain, dated July 31, 1915.
Captain John Lithgow, M.D., to be Major, dated August 1, 1915.
The date of promotion of Lieutenant Thomas Carnwath, M.B., to Captain is August 5, 1914, and not as stated in the *London Gazette* of October 4, 1915.
Major Arthur C. Hartley, M.D., is seconded, dated August 22, 1914.
Lieutenant Ismay D. Stubbs to be Captain, dated September 6, 1915.
Captain William F. Roe, to be Major, dated September 9, 1915.
Edwin Teynham Roper to be Lieutenant, dated September 9, 1915.
Lieutenant Robert L. Wood, M.D., to be Captain, dated September 12, 1915.
Lieutenant Wilfrid A. L. Jackson, M.B., from 3rd North Midland Field Ambulance, to be Lieutenant, dated September 13, 1914.
Lieutenant John K. Brownless to be Captain, dated September 16, 1915.
William Charles Dillon Hills to be Lieutenant, dated September 29, 1915.
Lieutenant Gerald W. C. Hollist to be Captain, dated September 30, 1915.
Lieutenant John Macquarrie, M.B., to be Captain, dated October 1, 1915.
Frederick Robert Henry Laverick, M.D., to be Lieutenant, dated October 7, 1915.
Basil George Ewing, M.B., to be Lieutenant, dated October 17, 1915.
Captain Morris Wilks, M.B., from 1st South Midland Field Ambulance, to be Captain dated October 23, 1915.

BIRTH.

DAWSON.—At Dalhousie, N. India, the wife of Major F. W. W. Dawson, R.A.M.C., of a son.

DEATH.

FORD.—Captain Ernest George Ford, M.B., late R.A.M.C., died at Wolston, near Coventry, on October 7, aged 40.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Captain R.A.M.C., into his seventh consecutive year in India; volunteered for Persian Gulf, East Africa, &c., and passed Board for admission to Royal Flying Corps; never been on sick list his whole service, willing to exchange with any war-worn officer requiring a rest and complete change. Apply "KEEN," c/o Holt & Co., 3, Whitehall Place, London.

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	8	0 6 9	0 3 2				
	16	0 12 0	0 5 3				
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200	4	0 8 6	0 4 0	9 0	6 3	7 6	4 0
	8	0 13 6	0 6 0				
	16	1 3 6	0 8 9				

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The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Surgeon General Sir George Makins, Colonel C. S. Wallace, Lieutenant-Colonel D. Harvey, Captain J. H. M. Frobisher, Lieutenant and Quartermaster H. Williams, Colonel R. H. Firth and Captain W. K. Beaman.

The following publications have been received:—

British: Proceedings of the Royal Society of Medicine, The Quarterly Journal of Medicine, The Hospital, The Lancet, The Sanitary Record and Municipal Engineering, The Journal of Tropical Medicine and Hygiene, Journal of the Royal Naval Medical Service, The Indian Medical Gazette, Guy's Hospital Gazette, Tropical Diseases Bulletin, Medical Press and Circular, The Medical Journal of Australia, The Practitioner, The Royal Engineer's Journal, The Medical Journal of South Africa.

Foreign: United States Naval Medical Bulletin, Giornale di Medicina Militaire, Norsk Tidsskrift fur Militaermedicin, Bulletin de l'Institut Pasteur, The Military Surgeon, Bulletin of the John Hopkins Hospital, Bulletin de la Société de Pathologie Exotique, The Philippine Journal of Science, vol. x, No. 4, Revista de Sanidad Militar, Le Caducée.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

The Hon. Manager,
"Journal of the Royal Army Medical Corps,"
War Office, Whitehall, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

SEPTEMBER, OCTOBER AND NOVEMBER, 1915.

War Office,
November 8, 1915.

THE President of the French Republic has been pleased to confer the decoration of the Legion of Honour on the undermentioned officer, with the approval of His Majesty the King, for distinguished service in the Field:—

CROIX DE COMMANDEUR.

Surgeon-General Sir Arthur Thomas Sloggett, K.C.B., C.M.G., K.H.S.

The King has been graciously pleased to give directions for the following appointments to the Most Distinguished Order of St. Michael and St. George, for distinguished service in the Field during the operations at the Dardanelles:—

To be additional members of the Third Class, or Companions, of the said Most Distinguished Order:—

AUSTRALIAN IMPERIAL FORCE.

Colonel The Honourable Joseph Livesley Beeston, Army Medical Corps.

NEW ZEALAND IMPERIAL FORCE.

Lieutenant-Colonel Charles Mackie Begg, New Zealand Medical Corps.

War Office,
November 4, 1915.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned officers to be Companions of the Distinguished Service Order, in recognition of their gallantry and devotion to duty in the Field:—

Major Geoffrey Wallace Grainger Hughes, 6th Cavalry Field Ambulance, Royal Army Medical Corps.

For conspicuous ability and good work in arranging for the care and evacuation of the wounded at Loos on September 26 and 27, 1915. A large number of wounded infantry were tended and evacuated by the two cavalry field ambulances in addition to wounded cavalrymen. During the greater part of the time Loos was under heavy bombardment.

Captain Whiteford John Edward Bell, M.B., No. 2 Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty on all occasions, notably near Loos, between September 28 and October 1, 1915, when he visited the advanced bearer post day and night under continuous shell fire and personally supervised the arrangements for collecting and evacuating the wounded in that area. Captain Bell has commanded a bearer division since August, 1914.

Captain (temporary Major) John Wilfred Bird, 6th London Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous devotion to duty during operations at Maroc and Loos, between September 25 and 30, 1915, in dealing with casualties. On one occasion he worked

for twenty-three hours without any cessation in dressing and tending the wounded. He set a fine example, which had far-reaching results.

Temporary Captain Charles Stewart Parnell Hamilton, Royal Army Medical Corps, attached 2nd Battalion, The Buffs (East Kent Regiment).

For conspicuous gallantry and devotion to duty from September 27 to 30, 1915, in France. He dressed the wounded in the firing line, being for hours together under heavy shell fire, and went to points of great danger, often to where bombers were actually fighting.

Captain Frank Robinson Kerr, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and splendid devotion to duty at Guinchy on September 25, 1915. After an unsuccessful attack on the enemy's trenches, this officer crawled over our parapet and brought in a wounded man from about a dozen yards outside in full view of the enemy at a range of only seventy yards. He then went out again for thirty yards and rescued a man whose thigh had been broken, being fired at the whole time.

During the night of September 25, Captain Kerr was out attending to the wounded for two hours under constant machine-gun and rifle fire, and on the night of September 27-28 he went to within twenty-five yards of the enemy's position to rescue a man reported wounded, but found that he was dead.

Captain Arthur John Alexander Menzies, M.B., Royal Army Medical Corps, attached 1st (Royal) Dragoons.

For conspicuous gallantry and devotion to duty from September 26-29, 1915, in Loos. Captain Menzies was unremitting in his attention to the wounded of all units. He was twice seen carrying wounded on a stretcher under rifle fire, and for fifty-five hours he was continually exposing himself to heavy shell fire while carrying out his duties.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned officers, in recognition of their gallantry and devotion to duty in the Field:—

Captain Frank Percy Freeman, Royal Army Medical Corps, Special Reserve, attached 23rd Field Ambulance.

For conspicuous gallantry and devotion to duty during operations near Hulluch, from September 25 to 28, 1915. He brought in and attended to the wounded during four consecutive days and nights, repeatedly going out under heavy fire. By his personal bravery and energy he set a splendid example to his men.

Captain James Ronald McCurdie, M.B., Royal Army Medical Corps, Special Reserve, attached No. 2 Field Ambulance.

For conspicuous gallantry and devotion to duty from September 25 to 27, 1915, at Le Rutoire farm, where, although continuously exposed to shell fire, he collected and treated the wounded. By his efforts and organizing power a large number of wounded were collected. Captain McCurdie set a fine example to the officers and men under him in most trying circumstances.

Temporary Captain James Murray McLaggan, M.B., Royal Army Medical Corps, attached 3rd Battalion, The Royal Fusiliers (City of London Regiment).

For conspicuous gallantry and devotion to duty during the operations between September 27 and 30, 1915, when he attended to the wounded in the firing line under heavy shell and rifle fire. His coolness and skill undoubtedly saved many lives. For three days and four nights he worked incessantly with unflagging energy.

Temporary Captain Charles Joseph O'Reilly, M.D., 21st Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during operations near Hulluch, from September 25 to 28, 1915. He brought in and attended to the wounded for four consecutive days and nights under heavy fire, notably on September 27, when he voluntarily went out to collect wounded under very heavy shell fire. He has consistently set a splendid example to his men.

Captain Thomas Walker, M.B., Royal Army Medical Corps, Special Reserve, attached No. 2 Field Ambulance.

For conspicuous gallantry and devotion to duty, from September 25 to 27, 1915, when he worked continuously collecting wounded from the area, Long Tree to Hulluch Road, and beyond. This area was under continuous shell fire, and at first under machine-gun fire also.

Temporary Lieutenant David Carnegie Alexander, M.B., Royal Army Medical Corps, attached 5th Battalion, The Queen's Own Cameron Highlanders.

For conspicuous gallantry and devotion to duty between September 25 and 27, 1915, near "Fosse 8." He attended to and got into shelter many wounded men who were

lying in the open under enfilade machine-gun fire, and on several occasions at the manager's house at the Fosse carried out his duties under heavy shell fire.

Temporary Lieutenant John Bruce Baird, No. 1 Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty from September 25 to 27, 1915, when in charge of different bearer sections collecting wounded in the area between Lone Tree and Hulluch Road under shell and machine-gun fire.

Temporary Lieutenant George Rankine, M.B., Royal Army Medical Corps, attached Headquarters, 9th Divisional Royal Engineers.

For conspicuous gallantry and devotion to duty, from September 26 to 28, 1915, at Sailly and Vermelles, when attending to and evacuating the wounded. On one occasion he went with a party of bearers as far as Hohenzollern Redoubt, and, in spite of shell fire and bombing, assisted to get back many wounded. On the return journey many of the bearers were killed and wounded by a shell, and Lieutenant Rankine carried in a wounded man on his back.

Temporary Lieutenant Bernard Score Browne, M.B., Royal Army Medical Corps, attached 2nd Battalion, The Cheshire Regiment.

For conspicuous gallantry and devotion to duty near Vermelles. He spent the whole night of October 2 and 3 searching for and carrying back wounded who were lying between our own and the enemy's lines, which were only 200 yards apart. The enemy were firing and the ground was lit up by flames. After daybreak he carried back three more men under a very heavy fire. At one time he tended the wounded within 15 yards of the enemy's trenches. By his courage and ceaseless work all the wounded in his area were brought in.

War Office,
London, S.W.,
November 5, 1915.

The following despatch has been received by the Secretary of State for War from the Commander-in-Chief, Mediterranean Expeditionary Force.

General Headquarters,
Mediterranean Expeditionary Force,
September 22, 1915.

My Lord, In continuation of my despatch of August 26, 1915. I have the honour to submit herewith the following additional names of officers, non-commissioned officers and men whose services, during the operations described therein, I consider deserving of special mention.

I have the honour to be,
Your Lordship's most obedient servant,
(sd) Ian Hamilton,
General, Commander-in-Chief,
Mediterranean Expeditionary Force.

Staff.

Lieutenant-Colonel A. E. C. Keble, Royal Army Medical Corps.
Captain J. Hare, M.B., Royal Army Medical Corps.

Royal Army Medical Corps.

Lieutenant-Colonel L. Humphry.
Major A. NcMunn.
No. 10431 Serjeant-Major H. Underwood.
No. 16177 Serjeant-Major A. F. Robinson.
No. 1643 Serjeant F. H. Mattock.
Major E. McDonnell, M.B.
No. 2166 Serjeant W. T. Mathias.
No. 31656 Serjeant B. T. Colls (dead).
No. 19254 Acting-Serjeant G. A. Scales.

Royal Army Medical Corps (T.F.)

Lieutenant-Colonel J. J. O'Hagan, T.D., M.B., F.R.C.S.I., West Lancshire Field Ambulance.
No. 223 Corporal R. Pain, attached Lancashire Fusiliers.
No. 1554 Private W. E. Lloyd, 88th Field Ambulance.
No. 407 Private G. A. Walton, East Lancashire Field Ambulance.
No. 149 Private H. Price, East Lancashire Field Ambulance.
No. 155 Private J. Morris, East Lancashire Field Ambulance.

AUSTRALIAN AND NEW ZEALAND FORCES.

Staff.

Colonel N. Manders, Army Medical Service (killed).

INDIAN MEDICAL SERVICE.

Captain T. J. C. Evans, F.R.C.S.

ARMY MEDICAL SERVICE.

Lieutenant-Colonel Hugh S. Thurston, C.M.G., to be temporary Colonel whilst holding the appointment of Assistant Director of Medical Services, dated October 3, 1915.

ROYAL ARMY MEDICAL CORPS.

David White Finlay, M.D., to be temporary Honorary Lieutenant-Colonel whilst holding the appointment of officer in charge Red Cross Hospital at Ballahouston, Glasgow, dated November 9, 1915.

Arthur Frederick Hertz, M.D., F.R.C.P., to be temporary Major, dated October 26, 1915.

The appointment to a temporary Lieutenancy of Fraser B. Gurd, M.D., is antedated to May 25, 1915.

Temporary Honorary Lieutenant Everard William Lewen Sharp to be temporary Lieutenant, dated September 27, 1915 (substituted for the notification which appeared in the *Gazette* of October 16, 1915).

The transfer of Captain Edward P. Minett from 6th London Field Ambulance, which was announced in the *London Gazette* of January 18, 1915, is cancelled.

The undermentioned to be temporary Captains:—

Dated June 2, 1915.—Captain Eric Leonard Dobson, Honourable Artillery Company, Infantry, Territorial Force.

Dated October 7, 1915.—Temporary Lieutenant John N. Clark.

Dated October 9, 1915.—John Henry Jones, late Staff Surgeon, Royal Navy.

Dated October 10, 1915.—Malcolm Ferguson.

Dated October 11, 1915.—Harry Meade, F.R.C.S.I.; Thomas Andrew Rothwell, M.D., late Surgeon Captain, 3rd Volunteer Battalion, the Cheshire Regiment.

Dated October 28, 1915.—Temporary Lieutenant William G. Brett.

Dated November 10, 1915.—Temporary Lieutenant Alexander Waugh, M.B.

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated September 19, 1915.—Edward Hamilton.

Dated October 1, 1915.—Eric F. W. Mackenzie, M.B.; Thomas E. Lawson; Frank E. Johnson; William MacEwen, M.B.; Philip H. Bahr, M.D.

Dated October 2, 1915.—Charles G. L. Wolf, M.D.; Clayton C. Morrell, M.D.; James Biggam, M.B.; Cuthbert Scales, M.B.; David Pottinger, M.B.; Leslie W. Howlett, M.B.; David Hardie, M.B.

Dated October 3, 1915.—Richard H. C. Gompertz, M.B.; Arthur B. Le Mesurier, M.B.; William A. Todd, M.B.; John McFadden, M.B.; Robert B. Blair, M.B., F.R.C.S.Edin.; Philip J. Watkin; Matthew Murphy; William R. MacKenzie.

Dated October 5, 1915.—Charles M. Kennedy, F.R.C.S.; Delvine Bell, M.B.; Edwin B. Barton, M.B.; John S. K. Boyd, M.B.; Douglas M. Borland, M.B.; William S. Garden, M.D.; John H. C. Green, M.B.; Aubrey Goodwin, M.B.; Stanley Honeyman, M.B.; Robert McC. Hill, M.B.; Alfred E. Hallinan, M.B.; Thomas H. Houston, M.B.; Courtnay C. Keates; David Matthew, M.B.; William S. Martin, M.B.; Henry M. MacKenzie, M.B.; Fred W. Mackenzie, M.B.; John T. Morrison, M.B., F.R.C.S.; Hugh L. Neil, M.B.; Ralph S. Oldham, M.D.; William B. C. Patterson, M.B.; George Rankine, M.B.; William R. Snodgrass, M.B.; James J. Sinclair, M.B.; James Taylor, F.R.C.S.Edin.; James H. Grove-White, M.D.; Donald Wainwright; Wilfred T. Chaning-Pearce, M.B.

Dated October 7, 1915.—Francis F. Muecke, M.B., F.R.C.S.

Dated October 8, 1915.—Arthur O. P. Reynolds, M.B.; Stanley Pinion, M.B.

Dated October 9, 1915.—Albert J. Best; William K. Calwell, M.B.; Hugh G. Wilson, M.B.; Douglas G. Cheyne, M.D.; Samuel E. Picken, M.B.; John L. Dunlop.

Dated October 10, 1915.—Robert H. Spittal, M.B.; Hubert W. Powell; Edward A. Walker, M.D.; Thomas S. Wright, M.B.; Ernest White, M.B.; Edward C. Gimson, M.B.; William E. Wallis, M.B.; William W. Forbes; Robert Kennon, M.D.; Francis E. Daunt, M.B.; David J. S. Stephen, M.D.; Philip A. Opie, M.B.; Charles G. Timms; Edgar Grey, M.B.; John Fleming, M.B.; Gordon S. Woodman, M.B.;

John P. Davidson, M.B.: William P. Hogg, M.B.; George Wilson, M.B.; John Scott, M.B.; James W. McLeod, M.B.; Bryce McC. Smith, M.B.; Lewis Anderson, M.B.; Henry G. Rice; David R. E. Roberts, M.B.; Ernest N. Snowden, M.B.; Kenneth G. Fraser; John S. Levis, M.B.; David R. Mitchell, M.B.; Denis J. Stokes, M.B.; Charles M. Smith, M.B.; John McL. Pinkerton, M.B.; William C. Douglass; Alan Wilson, M.B.; Malcolm K. Acheson, M.D.; Alexander Anderson, M.B.; Karl K. G. Dick; William G. Gordon, M.B.; John E. Staccy, M.B.; John V. O. Andrew; John Spence, M.B.; John P. Cahir, M.B.; Ernest F. C. Dowding; Thomas P. Cole, M.B.; John Parkinson, M.D.; John H. McNicol, M.B.; Reginald J. Wooster; William MacKenzie, M.B.: Edward W. Alment; Cedric R. Taylor, M.B.; Douglas W. Hunter, M.B.; James S. Somerville, M.B.; Thomas P. Lewis; Claude G. Douglas, M.D.; John W. Flood; Ralph F. Eminson, M.B.; William E. Hopkins, M.B., F.R.C.S.I.; Robert B. Wallace, M.B.; William B. Watson, M.B.; John Capell; Spencer Jackson, M.B.; Stanley Fenwick, M.B.; William E. Fetherstonhaugh, M.B.; John M. Forsyth, M.B.; Alexander E. Drynan, M.B.; Archibald S. K. Anderson, M.B.; James W. Brown; David S. Harvey, M.B.; Edward F. G. T. Heap; George Millar, M.B.; John Henderson, M.B.; Lawrence F. Hemmans, M.B., F.R.C.S.Edin.; William Baxter, M.B.; Thomas W. R. Strode; Newton Matthews, M.B.

Dated October 12, 1915.—Tremlett B. Batchelor; Noel A. Coward, M.D.; Ranald M. Handfield-Jones; John G. Ingouville; Michael J. Mulligan, M.B.; Michael Murphy, M.B.; George W. Milne, M.D.; Humphrey Neame, F.R.C.S.; Vivian M. Rich, M.B.; Edward L. N. Rhodes; George Thom; John Tichborne, M.D.; George W. Will, M.B.; Alfred S. Taylor, M.B.

Dated October 13, 1915.—William G. Lidderdale, M.B.

Dated October 14, 1915.—Magnus R. Mackay, M.B.

Dated October 15, 1915.—Frank A. Grange, M.B.; John D. Lithgow, M.B., F.R.C.S.Edin; James A. Smith, M.B.; Malcolm W. Shutte.

Dated October 16, 1915.—John W. Dew, M.B.

Dated October 17, 1915.—John H. D. Acland; Henry A. Ehrlich; Robert C. Irvine, M.B; Douglas E. Crosbie.

Dated October 19, 1915.—Herbert T. Retallack-Maloney; Arthur F. Palmer; Percy J. Chissell.

Dated October 20, 1915.—Claude Kingston.

Dated October 21, 1915.—William H. Brown, M.D.; Joseph H. Campian, M.B.; Gerald Cock; Walter J. I. Dwyer; Sydney H. Gibson; John C. B. Grant, M.B., F.R.C.S.Edin.; Alexander K. Hamilton, M.B.; Albert G. Miller, M.B.; Alexander T. McWhirter, M.B.; Patrick J. O'Reilly; John A. Pringle, M.D.; Edmund G. C. Price, M.B.; Thomas T. Rankin, M.D.; Percy C. Raiment; Ronald J. T. Thornhill, M.B.; Henry A. Treadgold, M.D.; Alfred W. Weston, M.B.; William M. Will, M.B.; John J. Walsh; William S. Milne, M.B.; Joseph G. Johnston, M.B.; George W. Rea, M.B.

Dated October 22, 1915.—Richard Charles, F.R.C.S.I.; Henry C. C. Rennie, M.B.; John H. O'Neill.

Dated October 23, 1915.—Arthur de W. Snowden, M.D.

Dated October 24, 1915.—Michael J. Kelly; Arthur G. Leitch; William W. Mackarell, M.D.; John B. Orr, M.B.; Maurice P. Scanlon, M.B.; Ernest A. Tozer, M.B.; John C. Anderson, M.D.; Alfred J. Andrew.

Dated October 26, 1915.—John MacInnes, M.B.; Herbert Emerson, M.B.

Dated October 29, 1915.—Robert L. Brown; Winslow S. S. Berry, M.B.

The undermentioned to be temporary Lieutenants:—

Dated June 8, 1915.—Alexander Brown, M.B.

Dated July 6, 1915.—Temporary Lieutenant Harold Parsons, M.B., from the Army Service Corps.

Dated August 1, 1915.—Charles Richard Maitland Pattison.

Dated September 12, 1915.—Harry Butson Maunsell.

Dated October 4, 1915.—Allan Semple, M.B.

Dated October 7, 1915.—John Henry Morris-Jones; Robert Chichester McMillan, M.B.

Dated October 9, 1915.—Seymour Whitney Davies, M.B.; Timothy Joseph Lloyd; Arthur John Brock, M.D.; Rupert Allen Clayton Rigby; Francis Joseph McGlade, M.B.; Charles Herbert Farley Johnston, M.D.; Charles Edwin Durrant; Charles Michael Roberts, M.B.; William Melville Christie, M.B.; Charles Samuel Kingston; Alexander Moxon Webber, F.R.C.S.

Dated October 10, 1915.—Arthur William Courtney Drake, M.B.; Rufus Clifford Thomas; Thomas McCall Sellar, M.B.; William Robert Wilson, F.R.C.S.I.; Pollok Donald, M.B.; Thomas Arthur Collinson; William Gillespie Bryson Gunn, M.B.; William O'Donnell; William Watt Farrar, M.B.

Dated October 11, 1915.—Samuel Wilson McComb, M.B.; Richard Robert Kirwan, M.B.; Robert Charles Muir, M.B.; William James Macdonald, M.B.; John Black, M.B.; Alwyne Harold Manfield; Cecil Granville McClymont; James Percival Scatchard, M.B.; Alban Dixon; Henry Robert Ramsbotham, M.B.; Victor Albert Chatelain, M.B.; James Batson Stephens, M.B.; John Williamson Frew, M.B.; Basil Henry Palmer, M.B.; John Norman Lonsdale Thoseley, M.B.; Alexander Graham Bryce, M.D.; Arthur Borland Porteous, M.B.; George Unsworth, M.B.

Dated October 12, 1915.—John Fletcher Strickland, M.B.; Nathaniel Troughton Bond, M.B.; Alexander Dingwall, M.B.; John Walter Burnett Thornburn, M.B.; Benjamin Poyntz Young; Malcolm McLean Morrison, M.B.; Charles Aloysius Keegan, M.B.; Arthur William Wakefield, M.D.; William Joseph Maloney, M.B.; Eric Wesley Thomas; Alfred Fisher Camp; Gwilym Tremain Davies.

Dated October 15, 1915.—Robert Robertson Kilpatrick, M.B.; Arthur Denison, M.D.; John Joseph Michael Dowzer; Thomas William Jackson, M.B.; Donald Frederick Dobson, M.B.; John Campbell Smith, M.B.; Harold Topham; William Douglas Anderson King, M.B.; George Norman Kirkwood, M.B.; John Miller, M.B.; John Wilson Mathie, M.D.; Arthur John Partridge, M.B.; Frederic Ritchie, M.B.; William Gerald Parkinson, M.B.; Walter Johnstone McKeand, M.B.; Cecil Alfred Dottridge, M.B.; Wilfred Robert Burton; John Frank William Waters; Robert Edward Smith; William Eardley, M.B.; George Blair, M.B., F.R.C.S.Edin.; Samuel Francis Allen Charles, M.D.; Thomas Macmillan Anderson, M.D.; George Cowley Gell; John Edward Thompson, M.B.; John Aloysius Pierse, M.B.; Robert Sidney Ellis, M.B.; William George Thomas Hepplewhite, M.D.; Ernest James Maxwell, M.B.; John Ownsworth Garland; temporary Honorary Lieutenant Frederick William Watkyn-Thomas; John Ambrose Whitaker; John Duguid; William Harold Waldman; Sidney John Vaughan Cox-Moore.

Dated October 16, 1915.—Francis James Browne, M.B., F.R.C.S.Edin.; Thomas Muir Crawford, M.B.; George Stevenson Gordon, M.B.; Stevenson Plumbe Moore, M.B.; William Beatson Drummond, M.B.

Dated October 17, 1915.—John Charsley Mackwood; James Joseph Reynolds; Edward Geake Lane.

The undermentioned to be temporary Honorary Lieutenants:—

Dated July 24, 1915.—James Reid Dick, M.B., whilst employed with No. 1 British Red Cross (Duchess of Westminster's) Hospital.

Dated October 21, 1915.—James Stuart Leslie.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated October 9, 1915.—Thomas Burges Welsh, M.B.; Alfred Noel Garrod; John Llewellyn Davies; Andrew Hunter Little; William Frank Thompson.

Dated October 24, 1915.—Robert Joel Cazalet Donty whilst serving with No. 2 British Red Cross Hospital.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated October 4, 1915.—Thomas John Simpson, M.B.; John George Moore Sloane, M.B.; Cecil John Sparrow, M.D.; Michael Joseph Casserley, M.D.; Arthur Clifford Johnston, M.D.

The undermentioned temporary Captains relinquish their commissions:—

Dated October 3, 1915.—Mark C. Gardner, M.B.

Dated October 5, 1915.—Godfrey M. Huggins, F.R.C.S.

Dated Octaber 30, 1915.—Arthur Matthey.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated September 19, 1915.—Albert Turner.

Dated October 2, 1915.—George C. Adeney, M.B., F.R.C.S.

Dated October 5, 1915.—Edmund R. Dermer; Charles D. Roberts; Dudley T. Birt; Alan W. Gaye, M.B.; James W. Littlejohn, M.D.; Neil F. Sinclair.

Dated October 6, 1915.—John H. Sheldon, M.B.

Dated October 7, 1915.—Ernest W. Milne, M.B.; David Riddell, M.D.

Dated October 9, 1915.—John Hewat, M.B.

Dated October 10, 1915.—William P. H. Munden, M.D.; James Fraser, M.B.; Patrick K. Murphy, M.B.; Reginald W. Gemmell, M.B.; James G. Copeland, M.B.;

James H. Connolly, M.D., F.R.C.S.; Christopher Elliott; Henry D. H. Willis-Bund; Francis F. Brown, M.B.

Dated October 12, 1915.—John Davidson, M.B.

Dated October 13, 1915.—Adam Gray, M.D.; Robert S. Taggart, M.B.

Dated October 21 1915.—Victor L. Connolly, M.B.; Douglas F. Kennard; Frederick G. Norbury; John T. W. Stewart, M.B.; Alexander Stephen, M.B.; George H. Urquhart, F.R.C.S.Edin.

Dated October 22, 1915.—James L. Whatley.

Dated October 24, 1915.—David N. Knox, M.B.; Andrew R. Hamilton, M.B.; Evan W. Griffith.

Dated October 25, 1915.—Horace C. Barr.

Dated October 28, 1915.—Thomas H. Agnew.

Dated October 30, 1915.—William S. Stevenson.

Dated October 31, 1915.—John B. Wood, M.B.

Temporary Honorary Lieutenant Andrew F. H. Rabagliati, M.D., relinquishes his commission on ceasing to be employed with No. 4 British Red Cross Hospital, dated October 24, 1915.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated October 21, 1915.—Arthur Percy Groves.

Dated October 23.—Edward Ezra Larner.

Dated October 25, 1915.—Walter Pryce Clifford Thomas.

Dated October 27, 1915.—Samuel Pitchford.

Dated November 1, 1915.—Frederick Leaf.

SPECIAL RESERVE.

Royal Army Medical Corps.

The undermentioned Lieutenants to be Captains:—

Dated October 1, 1915.—Gavin Young, M.B.; Peter MacCullum, M.B.

Dated October 5, 1915.—James S. Robinson, M.B.

Dated October 7, 1915.—Robert Forgan, M.B.

Dated October 10, 1915.—James O'Brien; Forster H. B. Norrie, M.B.; Robert B. Myles, M.B.; Gilbert W. Rose, M.B.

Dated October 14, 1915.—Douglas Cran, M.B.; Robert McKinley, M.B.; William B. Postlethwaite, M.B.; John O. Reid, M.B.; Patrick C. MacRae, M.B.

Dated October 16, 1915.—John McC. Orme, M.B.

Dated October 17, 1915.—Ian C. Mackay, M.B.

Dated October 19, 1915.—Henry P. Crow, M.B.; William B. Cathcart, M.B.; Frederick E. Feilden.

Dated October 20, 1915.—Neville H. Linzee.

Dated October 21, 1915.—Robert P. S. Mason.

Dated October 23, 1915.—Austin B. Clarke, M.B.; Thomas Young, M.B.

Dated October 24, 1915.—John F. Lyons; James G. Wilson, M.B.; Alfred T. Logan, M.B.

Dated October 26, 1915.—Raymond F. Pinson.

Dated October 30, 1915.—Robert Taylor.

The undermentioned Lieutenants (on probation) are confirmed in their rank:—

Maurice B. King, M.B.

Roland H. Graham, M.B.

Dated October 27, 1915.—John Bernard Cavenagh, M.B.

TERRITORIAL FORCE.

Royal Army Medical Corps.

1st London (City of London) Field Ambulance.—Captain Arthur D. J. B. Williams relinquishes his commission on appointment to the permanent Staff of the British East African Protectorate, dated August 15, 1915.

1st London (City of London) General Hospital.—The surname of Captain Joseph F. Trewby is as now stated, and not as announced in the *London Gazette* of September 4, 1914.

1st London Casualty Clearing Station.—Lieutenant Cecil A. Robinson to be Captain, dated October 10, 1915.

2nd London (City of London) Field Ambulance.—Serjeant-Major John James, from 3rd London (City of London) Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated November 6, 1915.

2nd London (City of London) General Hospital.—The following announcement is substituted for that which appeared in the *London Gazette* of October 2, 1915: Frederick Douglas Selmes Jackson to be Captain, whose services will be available on mobilization, dated October 3, 1915.

2nd London Sanitary Company.—John Inglis to be Lieutenant, dated October 30, 1915.

3rd London General Hospital.—Lieutenant Roger P. Ninnis, M.B., resigns his commission on account of ill-health, dated November 14, 1915.

5th London Field Ambulance.—Lieutenant Robert W. Baron, M.B., resigns his commission on account of ill-health, dated November 9, 1915.

6th London Field Ambulance.—The following announcement is substituted for that which appeared in the *London Gazette* of September 13, 1915: Captain Edward P. Minett is restored to the Establishment, dated August 16, 1915.

Highland Casualty Clearing Station.—Lieutenant James Davidson, M.B., to be Captain, dated October 23, 1915. The undermentioned Lieutenants to be Captains, dated October 25, 1915: Joseph E. Milne, M.D.; Charles Forbes, M.B.; Alexander J. Presslie, M.B.; James McL. Macfarlane, M.D.; Alexander Fraser McBean, M.B., to be Lieutenant, dated October 22, 1915.

Highland Mounted Brigade Field Ambulance.—Ronald William Cadell Macdonald, M.D. (late Surgeon-Lieutenant, 8th Volunteer Battalion, The Royal Scots), to be Captain, dated September 26, 1915.

1st Lowland Field Ambulance.—Lieutenant Frank M. Robertson, M.B., to be Captain, dated October 19, 1915.

2nd Lowland Field Ambulance.—Lieutenant William J. Scade, M.B., to be Captain, dated October 19, 1915. William Goldie, M.B. (late Lieutenant, 6th Battalion, The Royal Scots), to be Lieutenant, dated November 14, 1915.

1st Northern General Hospital.—The undermentioned Lieutenants to be Captains: William Stott, M.B., dated October 14, 1915; Thomas Whitelaw, M.B., dated October 20, 1015. Captain Wilfred E. Alderson, M.D., from attached to units other than medical units, to be Captain, whose services will be available on mobilization, dated November 6, 1915.

3rd Northern General Hospital.—Nathan Judah Wigram to be Lieutenant, dated October 14, 1915. Alfred Ernest Turnell (late Quartermaster and Honorary Lieutenant, 4th West Yorks Royal Engineers (Volunteers)), to be Quartermaster, with the honorary rank of Lieutenant, dated October 14, 1915.

4th Northern General Hospital.—Captain Arthur A. Pratt, M.D., is seconded for duty with a Casualty Clearing Station, dated October 27, 1915.

Northumbrian Casualty Clearing Station.—The undermentioned Lieutenants to be Captains, dated September 29, 1915: Fred Phillips, M.B.; Stanley McCoull, M.B.

2nd West Riding Field Ambulance.—The date of promotion of Lieutenant Wallace W. Adamson, M.B., is April 1, 1915, and not as stated in the *London Gazette* of October 12, 1915.

3rd West Riding Field Ambulance.—The date of promotion of Lieutenant Ernest White to Captain is April 1, 1915, and not as stated in the *London Gazette* of September 20, 1915.

1st South Midland Mounted Brigade Field Ambulance.—The date of appointment of Lieutenant Samuel Percy Johnson, M.B., is September 24, 1915, and not as stated in the *London Gazette* of October 1, 1915.

1st South Midland Field Ambulance.—Lieutenant Edmund Whichello, M.B., to be Captain, dated October 16, 1915.

3rd South Midland Field Ambulance.—The appointment of David McVea Fleck, M.B., as Lieutenant, which was announced in the *London Gazette* of April 19, 1915, is cancelled.

North Midland Mounted Brigade Field Ambulance.—The following announcement is substituted for that which appeared in the *London Gazette* of July 6, 1915: Lieutenant Lionel A. Dingley, M.B., to be Captain, dated April 1, 1915.

East Lancashire Casualty Clearing Station.—Captain Thomas B. Wolstenholme, M.B., to be temporary Major, dated November 6, 1915.

3rd East Lancashire Field Ambulance.—Frederick William Marsden (late Major, 2nd East Lancashire Brigade, Royal Field Artillery) to be Major, dated October 27, 1915. Major Robert C. Rodgers, 5th Battalion, the East Lancashire Regiment, to be Major (temporary), dated November 11, 1915.

2nd West Lancashire Field Ambulance.—Transport Officer and Honorary Lieutenant Clive Whateley Robinson resigns his commission, dated November 3, 1915.

Welsh Border Mounted Brigade Field Ambulance. — William Morgan to be Lieutenant, dated July 16, 1915.

1st Southern General Hospital.—Major James T. J. Morrison, M.B., F.R.C.S., to be Lieutenant-Colonel, dated November 14, 1915.

3rd Southern General Hospital.—Eric Danvers Macnamara, M.D., F.R.C.P., to be Captain, whose services will be available on mobilization, dated October 19, 1915. Gathorne Robert Girdlestone, M.B., F.R.C.S., to be Captain, whose services will be available on mobilization, dated October 23, 1915.

2nd Wessex Field Ambulance.—Captain Harold C. Adams to be temporary Major, dated November 6, 1915.

Wessex Casualty Clearing Station. — Charles Telfer to be Lieutenant, dated October 10, 1915.

South-Eastern Mounted Brigade Field Ambulance.—Lieutenant Alexander G. S. Logie, M.B., to be Captain, dated October 19, 1915; Lieutenant Cholmondeley Webb to be Captain, dated October 22, 1915.

2nd Eastern General Hospital.—Captain Charles H. Benham, M.D., is seconded for duty with a General Hospital, dated November 1, 1915.

2nd South-Western Mounted Brigade Field Ambulance.—Transport Officer and Honorary Lieutenant Thomas Shaw relinquishes his commission on account of ill-health, dated November 14, 1915.

ATTACHED TO UNITS OTHER THAN MEDICAL UNITS.

The date of resignation of Captain William M. Fergusson is June 1, 1915, and not as stated in the *London Gazette* of June 26, 1915.

Lieutenant William Brown, M.D., to be Captain, dated June 27, 1915.

Lieutenant Arthur H. Fullerton, M.B., to be Captain, dated July 14, 1915.

George Johnston, M.B., to be Lieutenant, dated September 24, 1915.

Lieutenant Andrew L. McCully, M.B., to be Captain, dated October 8, 1915.

Lieutenant Leonard H. H. Boys, to be Captain, dated October 17, 1915.

Lieutenant Edward S. Johnson, to be Captain, dated October 25, 1915.

Lieutenant William L. Griffiths, M.D., F.R.C.S., relinquishes his commission on account of ill-health, dated November 14, 1915.

MARRIAGE.

HEMPHILL—SMITH.—October 30, 1915, at the Church of the Holy Saviour, Bitterne, Southampton, by the bridegroom's father, assisted by the Rev. A. Walcott Crockett, M.A., Vicar of Bitterne, Captain Robert Hemphill, R.A.M.C., Medical Officer in Charge, 5th Dragoon Guards, eldest son of the Rev. Samuel Hemphill, Litt.D., Chaplain of the Magdalen Asylum, Dublin, and Examining Chaplain to the Archbishop of Dublin, to Kathleen Ada, younger daughter of the late Augustus H. Smith, F.R.G.S., formerly Lieutenant R.N., and of Mrs. Smith, of The Ridge, Bitterne, Hants.

DEATH.

TURNER.—Honorary Brigade Surgeon Alexander Turner, M.D., Lieutenant-Colonel, retired, Army Medical Staff, died at 26, Athenæum Street, Plymouth, on October 31, 1915, aged 75.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

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25	4	0 3 0	0 1 3				
	8	0 5 6	0 2 6	4 0	1 3	3 6	0 9
	16	0 9 6	0 4 6				
50	4	0 4 0	0 1 8				
	8	0 6 9	0 3 2	5 0	1 9	4 0	1 0
	16	0 12 0	0 5 3				
100	4	0 5 6	0 2 9				
	8	0 9 0	0 4 4	6 6	3 3	5 6	2 0
	16	0 16 9	0 6 9				
200	4	0 8 6	0 4 0				
	8	0 13 6	0 6 0	9 0	6 3	7 6	4 0
	16	1 3 6	0 8 9				

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These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Colonel Andrew Balfour, C.M.G., Colonel R. J. Reece, Colonel J. B. Wilson, Captain W. C. B. Meyer, Captain A. Stokes, Lieutenant A. Compton, Lieutenant J. W. Dew, Dr. E. C. Hort.

The following publications have been received:—

British: Red Cross and Ambulance News, The Medical Review, Journal of the United Service Institution of India, Public Health, The Journal of State Medicine, The Journal of Tropical Medicine and Hygiene, The Army Service Corps Journal, Medical Press and Circular, The Medical Journal of Australia, Yellow Fever Bureau Bulletin, The Hospital, The Sanitary Record and Municipal Engineering, Guy's Hospital Reports, The Lancet, St. Bartholomew's Hospital Journal, The Indian Medical Journal, Tropical Diseases Bulletin.

Foreign: Bulletin de l'Institut Pasteur, Journal of Infectious Diseases, Revista de Sanidad Militar, Le Caducée, Office International d'Hygiène Publique.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

NOVEMBER AND DECEMBER, 1915.

War Office,
November 18, 1915.

HIS MAJESTY THE KING has been graciously pleased to approve of the grant of the Victoria Cross to the undermentioned Officer, in recognition of his most conspicuous bravery and devotion to duty in the field :—

Temporary Lieutenant George Allan Maling, M.B., Royal Army Medical Corps.

For most conspicuous bravery and devotion to duty during the heavy fighting near Fauquissart on September 25, 1915.

Lieutenant Maling worked incessantly with untiring energy from 6.15 a.m. on the 25th till 8 a.m. on the 26th, collecting and treating in the open under heavy shell fire more than 300 men. At about 11 a.m. on the 25th he was flung down and temporarily stunned by the bursting of a large high-explosive shell, which wounded his only assistant and killed several of his patients. A second shell soon after covered him and his instruments with dèbris, but his high courage and zeal never failed him and he continued his gallant work single-handed.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers, in recognition of their gallantry and devotion to duty in the Field :—

Captain Maurice Holdsworth Barton, Royal Army Medical Corps, Territorial Force, attached 5th Battalion, The Leicestershire Regiment.

For conspicuous gallantry and devotion to duty at Hohenzollern Redoubt on October 13, 1915, in tending and bringing in wounded under fire. He also rallied and sent forward men who had become scattered. This is not the first time that Captain Barton's bravery and good work have been brought to notice.

Captain Samuel Russell Foster, M.B., 2nd North Midland Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty at Hohenzollern Redoubt on October 16, 1915. He went to the relief of an officer and some wounded men who

were lying in a trench between the firing lines, passing over a considerable space of open ground in broad daylight under heavy shell, machine-gun and rifle fire. He spent eight hours in this trench tending severely wounded men.

War Office,
November 16, 1915.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-commissioned Officers and Men for acts of gallantry and devotion to duty whilst serving with the Expeditionary Forces in France and Flanders and at the Dardanelles:—

1000 Acting Lance-Corporal B. S. Franklin, 2nd Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry from September 29 to October 1, 1915, near Loos. While in charge of advanced bearer post he displayed the greatest bravery and devotion to duty. By his initiative he rescued many wounded from the village of Loos and from the surrounding trenches, and his fine example was instrumental in keeping up the moral of the men under him. The post was under heavy and continuous shell fire.

12519 Quartermaster-Serjeant R. E. Halford, 21st Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty from September 25 to 28. 1915, near Hulluch. Quartermaster-Serjeant Halford for four consecutive days and nights, without rest, and under very heavy shell fire, attended to and brought in the wounded. and, although wounded on the evening of September 26, he continued with great coolness and bravery to collect and bring in wounded for several hours under heavy shell fire. On the evening of September 27 he again voluntarily went out to collect the wounded on the Hulluch Road, which was under heavy shell fire at the time.

1105 Serjeant J. W. Hancock, 4th London Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty from September 25 to 28, 1915, at Loos and Maroc, when he repeatedly went out with the stretcher-bearer sub-division and rendered the most valuable service in directing and assisting in the work of the removal of the wounded from the field under heavy fire. By his bravery and coolness he set an example which went far to contribute to the success of the work of the other bearers.

1815 Quartermaster-Serjeant G. P. Pursey, 2nd Field Ambulance, Royal Army Medical Corps.

For conspicuous bravery, notably from September 28 to October 1, 1915, as senior non-commissioned officer of a bearer division, when he showed the greatest courage and total disregard of personal danger in collecting and evacuating wounded from the village of Loos and the neighbouring trenches, which were under a heavy and continuous fire.

32674 Lance-Corporal J. Sweeney, 42nd Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry on September 25, 26 and 27, 1915, at Hooge, when he stayed in an open trench under very heavy shell fire, directing the stretcher-bearers and dressing many wounded. Lance-Corporal Sweeney continued this duty for twenty-seven hours, and then led stretcher-bearer parties up and down the trenches to the advance trenches, working incessantly for forty-eight hours. His devotion to duty was most marked.

39419 Private G. T. Veitch, 39th Field Ambulance, Royal Army Medical Corps.

For conspicuous bravery on August 22, 1915, during operations near Gaba Tepe (Dardanelles). An advance was being made by rushes over a space swept by shrapnel fire. As each rush passed over, numerous dead and wounded were left lying within the danger zone. Private Veitch voluntarily went out and remained attending to the wounded and bringing as many as possible into safety, in spite of the fact that it was only at the greatest personal risk that the ground could be passed over. He remained under the hail of bullets for nearly half an hour. His bravery and devotion to duty were beyond praise.

ARMY MEDICAL SERVICE.

Colonel William W. Pike, D.S.O., F.R.C.S.I., to be temporary Surgeon-General whilst holding the appointment of Director of Medical Services of an Army, dated November 1, 1915.

Colonel William W. Pike, D.S.O., on completion of four years' service in his rank, is retained on the Active List, under the provisions of Article 120, Royal Warrant for pay and promotion, and to be supernumerary to Establishment, dated November 9, 1915.

Colonel Edwin Lee, from the Territorial Force Reserve, to be Assistant Director of Medical Services, 3rd Army, Central Force, dated November 10, 1915.

Archibald Edward Garrod, M.D., F.R.C.P., to be temporary Colonel, dated November 15, 1915.

Temporary Colonel Frederick F. Burghard, M.D., F.R.C.S., relinquishes his commission, dated October 25, 1915.

ROYAL ARMY MEDICAL CORPS.

Lieutenant-Colonel Charles Averill, M.D., from Deputy Assistant Director of Medical Services to be Assistant Director of Medical Services, Welsh Division (temporary), dated October 3, 1915.

Major John G. Bell, M.B., to be temporary Lieutenant-Colonel whilst an Assistant Director of Medical Services, dated June 4, 1915.

Richard John Morris, M.D., late Surgeon-Major, The King's Own (Royal Lancaster Regiment), Territorial Force, to be temporary Lieutenant-Colonel, dated October 18, 1915.

Captain Alexander S. M. Macgregor, M.D., from Attached to Units other than Medical Units, to be Deputy Assistant Director of Medical Services, Lowland Division (temporary), dated July 11, 1915.

Captain (temporary Major) Henry J. Dunbar, M.B., from 2nd Welsh Field Ambulance, to be Deputy Assistant Director of Medical Services, Welsh Division (temporary), dated October 3, 1915.

The undermentioned to be temporary Majors :—

Dated August 5, 1915.—Surgeon-Major A. C. Stamberg, M.D., Medical Corps, The Royal Militia of the Island of Jersey.

Dated October 30, 1915.—Henry Edward Leigh Canney, M.D.

Dated November 5, 1915.—Lieutenant-Colonel Charles Edward Ligertwood, M.D., late 5th Mounted Rifles, Imperial Light Horse.

Dated November 16, 1915.—Alexander Charles O'Sullivan, M.B.

Dated November 20, 1915.—Temporary Captain Alfred H. Carter, M.D.

Dated November 25, 1915.—Temporary Captain Ernest H. Starling, M.D.

Dated November 27, 1915.—Temporary Captain Arthur Martin Leake, V.C., F.R.C.S.

Dated November 30, 1915.—Hugh Lett, M.B., F.R.C.S.

The undermentioned to be temporary Majors whilst employed with the Huddersfield War Hospital :—

Dated October 4, 1915.—Peter MacGregor, F.R.C.S.Edin. : John George Rowell.

The undermentioned temporary Lieutenants to be temporary Captains :—

Dated September 15, 1915.—John J. A. Sherry.

Dated September 19, 1915.—James R. Gyllencreutz ; Edward Hamilton.

Dated September 21, 1915.—Lewis H. F. Thatcher, M.D. ; Isaac B. D'Olier, M.D. ; Leslie H. Skene, M.B.

Dated October 2, 1915.—Wallace McC. Conley, M.B.

Dated October 5, 1915.—Daniel McVicker, M.B. ; John S. Stewart, M.B.

Dated October 10, 1915.—Guy A. C. Mitchell, M.B. ; Victor D. O. Logan, M.B. ; Charles M. Forster.

Dated October 19, 1915.—Cecil H. Treadgold, M.D.

Dated October 21, 1915.—James G. Higgins ; Albert J. McC. C. Morrison, M.B.

Dated October 24, 1915.—Arthur S. Blackwell, M.D., F.R.C.S.

Dated October 25, 1915.—Robert W. Michell, M.D., F.R.C.S. ; Charles McM. Wilson, M.D.

Dated October 28, 1915.—Louis Cassidy, M.B., F.R.C.S.I.
Dated October 29, 1915.—David W. Woodruff.
Dated November 1, 1915.—Leslie Haden Guest; Claude G. Colyer; Horace C. Colyer, Stanley A. Riddett; Charles Weller; Frederick W. Broderick; George G. Timpson; Horace A. Cutler, M.B.; Richard P. Rosser, M.B.; Charles E. H. Smith; Reginald J. Rogers, F.R.C.S.Edin.; Herbert L. Hatch, M.B.; James K. Clarke, M.B.; Peter Drummond, M.B.; David J. Evans, M.B.; William A. L. Dunlop; Daniel McKelvey, M.B.
Dated November 2, 1915.—Charles L. Graham, M.B.; Charles D. Pye-Smith, M.B., F.R.C.S.; William A. Hislop, M.B.; John Alexander, M.B.; Thomas B. Johnstone; Charles M. Bernays; Ralph S. Renton, M.D.; Richard B. Llewellyn, M.B.; Robert Crothers, F.R.C.S.Edin.; Peter H. Robertson, M.B.; Laurence W. Pole, M.B.; William Tregenza; Robert Thomson, M.B.; Harry V. White, M.D.; Sydney Jacob.
Dated November 3, 1915.—Octavius S. Maunsell.
Dated November 4, 1915.—William F. Neil, M.B., F.R.C.S.; Arthur R. Muir; William B. Clark, M.B.; Thomas S. G. Martin; Alexander Hunter, M.B.; Cecil Powell, M.B.
Dated November 5, 1915.—Samuel McM. McLay, M.B.
Dated November 6, 1915.—Sydney A. Tucker, M.B.; Julius M. Bernstein, M.B.; Millias Culpin, M.B., F.R.C.S.; Charles F. Constant.
Dated November 7, 1915.—Henry M. Moir, M.B.; Courtenay Yorke, M.D., F.R.C.S.; John Stevenson, M.B.
Dated November 9, 1915.—Reginald J. Hearn; Alexander K. Forbes, M.B.; Albert L. Walker, M.B., F.R.C.S.; George F. Petrie, M.D.; Herbert G. M. Henry, M.D.; Ernest F. W. Buckell.
Dated November 10, 1915.—Godfrey W. Mitchell; Thomas M. Newton, M.B.; Lawrence Crombie, M.B.; Sidney J. Cullum, M.D.; John H. Dancy; Albert E. Cotterill; Charles W. Smith, M.B., F.R.C.S.Edin.; Robert Craig, M.B.

The undermentioned to be temporary Captains:—
Dated October 10, 1915.—Temporary Lieutenant Charles H. Robson, M.B.
Dated October 18, 1915.—William Henry Payne, M.D.
Dated October 20, 1915.—Francis Peake Maitland.
Dated October 21, 1915.—Robert Cecil Turle Evans, M.B., late Captain, 1st London Royal Engineers (Volunteers).
Dated October 22, 1915.—Aubrey Dean Vernon-Taylor.
Dated October 25, 1915.—Walter Theodore Ohlmus.
Dated October 27, 1915.—George Gunnis Ferguson, M.B., late Surgeon-Captain, London Scottish Rifle Volunteers.
Dated October 28, 1915.—Surgeon-Captain Charles Noble le Brocq, M.D., Medical Corps, The Royal Militia of the Island of Jersey.
Dated November 1, 1915.—Temporary Lieutenant George E. Vilvandré.
Dated November 3, 1915.—John Rupert Collins, M.D.; James Christopher Reginald Braime-Hartnell, F.R.C.S.Edin.
Dated November 4, 1915.—Thomas Walcot, M.D.
Dated November 12, 1915.—Major Edward Wrigley Braithwaite, from The Prince of Wales's Own (West Yorkshire Regiment). Territorial Force.
Dated November 13, 1915.—Temporary Lieutenant Richard Le G. Worsley.
Dated November 15, 1915.—Temporary Lieutenant Philip N. Vellacott, M.B., F.R.C.S., late Captain, South African Constabulary.
Dated December 4, 1915.—Temporary Lieutenant John Lunn, M.B.; Temporary Lieutenant Arthur G. Mossop.

The undermentioned to be temporary Lieutenants:—
Dated September 27, 1915.—Francis Christopher Plummer, M.B.
Dated October 12, 1915.—Lieutenant Gordon Blanchard Wiswell, M.D., Canadian Army Medical Corps.
Dated October 14, 1915.—Alexander Gold Waddell, M.B.
Dated October 15, 1915.—Lieutenant Hamnett Townley Douglas, M.D., Canadian Army Medical Corps.
Dated October 18, 1915.—Seymour Cochrane Shanks, M.B.; Graham Morris, M.D.; Edwin Charles Girling, M.B.; Thomas William Sweetnam, M.B.; John Davy Evans, M.B.; John James McMillan, M.D.; George Francis Hegarty; Frederick Morres; Frank Shirley Adams, M.B.; Andrew Neilson, M.B.; Richard Denton

Attwood; Robert Lewis Thornley, M.D.; Frederick Whitaker; Alexander Wilson Frew; Frank Hodson Bromhead, M.B.; Edwin Boyers, M.B.; Herbert Arthur Luke Banham; Alan William Holthuson, M.B.

Dated October 19, 1915.—William Noel Hazerigg Bell; William Hornsby, M.B.; David Sims.

Dated October 20, 1915.—John Gordon Sharp, M.D.; George Clark Stewart, M.B.; Maurice Davies, M.B.; Arthur Norman Haig, M.B.; John Stevenson Mitchell, M.B., F.R.C.S.Edin.; William Halliday Welsh, M.D.; Alexander Gibson Henderson, M.D.; David Gair McRae; Halford Thomas Wilkins.

Dated October 21, 1915. — James Bradley-Hughes; Walter Mercer, M.B.; Eugene Aaron Bernard; Ralph Campbell Lindsay Batchelor, M.B.; Frederick John Cleminson, F.R.C.S.; Bryen McDermott.

Dated October 22, 1915.—William Christopher MacFetridge, M.D.; Charles Hunter Graham, M.D., F.R.C.S.Edin.; John James MacRitchie, M.D.

Dated October 23, 1915.—Alfred Bealy Blomfield; James Broomhead, M.B.; Edward Maynard Ashcroft, M.B.; Eric Bellingham Smith, M.D.; William Benjamin Walker, M.B.; Thomas Mulcahy; Thomas Fletcher Lumb; Edward James Primrose, M.D.; Stephen Francis Smith; Frank Vause, M.B.; Robert Moir Lechmere Anderson, M.B.; Thomas Dick McLaren, M.B.; Arthur Herbert Spicer, M.B.

Dated October 24, 1915.—Harry Spong.

Dated October 25, 1915.—Michael McNiff, M.B.; Francis Seward Beachcroft; Campbell Kay Stevenson, M.B.; Sydney John Darke, M.B.; Vincent Middleton Coates; Charles Alexander Robertson Gatley; Robert Bain Lothian, M.B.; George Stewart Murray, M.D.; Kenneth Norman MacLean, M.B.; Frank William Martyn, M.B.; Alexander Charles Edward Gray, M.D.; James McDonald, M.B.; Reginald Peter Nutcombe Brickland Bluett; Frederick Buick McCarter, M.B.; Sidney Trevor Davies; Ernest Osmond Gilkes; Charles Digby Halcomb, M.B.; Alexander Bruce Simpson, M.B.; Andrew Paton Gray, M.B.; Alexander Fitzgerald Grattan Guinness; George Reid, M.B.; Thomas William Newton Dunn, M.B.; Bertram Marriott Bennett, M.B.; Alfred William Popert; Harry Angell Lane; James Raffan, M.D., F.R.C.S.Edin.; William MacDermott, M.B.; Wilfred Guy Stuart Neeley.

Dated October 26, 1915.—James Grant Morrin; William James Olivey; Rainald Heaton; Roderick MacGill.

Dated October 27, 1915.—Sidney Langford Hinde; Richard Burges; Herbert Newsome, M.B.; Dyfrig Huws Pennant; Reginald Robert Elsworthy, M.D.

Dated October 28, 1915.—Richard Fenton Theodore Newbery, M.B.; Alexander Mills Kennedy, M.D.; William Allan Higgins, M.B.; George Turnbull Walker, M.B.; Joseph Patrick McGreehin, M.B.; Donald John MacDougall, M.B.; John Hughes Murray, M.B.; Robert Kinnear Hay Gillespie, M.B.; Alexander Dick, M.B.; Hugh Laurence McCormick, M.B.; Norman William Gilchrist, M.B.; Charles Reginald Edwards; John Rigby, M.B.; Edward Henry Wheeler; Kenneth McAlpin Ross, M.B.

Dated October 29, 1915.—John Kerr Muir.

Dated October 30, 1915.—Gerald Straun Marshall; Eric Llewellyn Ivens; John McMillan, M.B.

The undermentioned are granted temporarily the honorary rank of Lieutenant whilst serving with No. 2 British Red Cross Hospital:—

Dated July 7, 1915.—Ernest Charles Arnold, M.B., F.R.C.S.

Dated August 11, 1915.—James Lindsay, M.D.; Ernest Milne Eaton, M.B.; Frederick Wood Hamilton, M.B.; Lorimer John Austin, M.B., F.R.C.S.

Dated September 29, 1915.—Patrick Henry Lang, M.B.

Dated October 7, 1915.—David Phillips Williams.

Dated October 18, 1915.—John Mathieson Macmillan.

Dated October 22, 1915.—Walter Alexander Crane.

Dated October 25, 1915.—Richard Austin Cooper; Herbert Vincent Morley; John Alphonsus Joseph Tighe; Temporary Second Lieutenant Stanley Lawson, from The Leicestershire Regiment; Lieutenant Fred Halsall, from The Prince of Wales's (South Lancashire Regiment).

Dated October 26, 1915.—Caswell Glynne Bowen; Arthur Bramston Austin.

Dated October 28, 1915.—Robert Reid; Percy Ravenscroft.

Dated October 30, 1915.—Stephen Wilson Charles.

Dated November 1, 1915.—William Arthur Rees, M.D., F.R.C.S.; Oswald Harry Anderson; Andrew Kelt; Bertie Mendleson; Henry Vincent Gibbons; Francis Robert McCambley; John Clark Yoeman; Andrew George Wilson; Claud Wyatt.

Dated November 2, 1915.—Patrick Kinmont, M.D., F.R.C.S.Edin.; Robert Thomas Forster, M.B.; Ronald Stevenson Dickie, M.B.; Francis Wardlaw Milne, M.D.

Dated November 3, 1915.—Norman Frederick Hallows, M.B.; Edward Segs Massiah, M.B.; Robert Forbes, M.B.; David Saunders Jones; Henry Edgar Barnes, M.D.; Hector Kenneth Macdonald, M.B.; Eric Bernard Armitage.

Dated November 4, 1915.—Cyril Courtenay Lord; Chambre Corker Vigurs, M.D.; Francis de Courcy Keogh, M.B.; Wilfred Jameson; Charles Bannigan, M.B.; Joseph Allan MacLean, M.B.; Frederick William Hobbs; Francis Brunel Hawes; Henry Stagg Byers, M.D.; William Alexander Ferguson; Wharram Henry Lamplough, M.D.

Dated November 5, 1915.—Edgar Douglas Batty; Robert Andrew George Elliott, M.B.; William Land Dibb, M.B.; James MacRae; Thomas Hugh Edey; William Douglas Newland; Edward Hesketh Roberts, M.B.

Dated November 6, 1915.—Frederick Bennett Julian, M.B.; James Alexander Richard Thompson, M.B.; William George Frederick Johnson; Alfred Cresswell Taylor; Robert Evans Thomas, M.D.; Armitage Edward Frederick Litton Forbes.

Dated November 7, 1915.—Arthur Gerald Forrest; Ernest Patrick Titterton; Thomas Davidson, M.B.; George Arthur Gordon, M.D.; Percival Cecil Hardinge Ryan, M.D.; Maynard Lambert Loveless.

Dated November 8, 1915.—Rupert William Percival Jackson; Robert Taylor Todd, M.B.; William Robert Percival McNeight, M.D.; James Ogilvie; Arthur Edward Schokman; Ernest William Nowell Wooler, M.B.; Alexander George Hains Moore; James Largue Murray Smith, M.B.; William Barbour, M.B.; Samuel McNair; Albert Sophron Sieger; Richard Kenyon, M.B.; James Moffat, M.B.; John Crawford; William Butement, M.B.; William Frederick Walker; Frederick William Lee; Robert William Macpherson, M.D.; John Milo Ryan, M.B.; Laurence Sebastian Cecil Roche; Andrew Rutherford, M.B.; Charles Wilmot Wanklyn James.

Dated November 12, 1915.—Archibald James Gwatkin; George Kennaway Mallory; Frank Allday; Alan Douglas Edward Shefford; Percy George Hastings Cox-Moore.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated October 27, 1915.—George William Racey, M.B.; Leonard Hugh Douglass, M.D.; Thomas Alexander Brandon, M.B.; Charles R. Totton, M.B.; David Caw Wilson, M.D.; James Davis Curtis, M.B.

The undermentioned to be temporary Lieutenants:—

Dated June 6, 1915.—William Bunting Wamsley, M.B.

Dated July 5, 1915.—Donald Meek, M.B.

Dated November 1, 1915.—Alexander Dick, M.B.; Alfred Joseph Dunlop, M.B.; John Wesley Bennett, M.B.; Charles Witts, M.B.; Charles George Lambie, M.B.; Alan Richmond Snowdon; Evan Clarence Ellis Van-Eyck; Ion Keith-Falconer MacLeod, M.B.; Hugh Campbell Highet, M.D.; Robert George Allen; Arthur Denys Rope, M.B., William Percival Ker; Bernard Watson Jones, M.B.; Thomas Harold Gibbs, M.B.; James Fenwick Robertson; Thomas Fryer O'Kell; John Noonan Meade; David Peter Gaussen, M.D.; John Webster Bride, M.D.; Ernest William Shaw Hughes; William Square Edmond, F.R.C.S.; Bryan Joseph Nolan; Daniel Viliesid; Eldon Munro Litchfield; William Moir Shepherd, M.B.; Philip Melancthon Ragg, M.B.; Harvie Anderson Forrester, M.B.; David Mann, M.B.; F.R.C.S.Edin.; Arthur Forbes Elliott, M.B.; Alfred Edmund Francis Fonnereau Huntsman; Frederick John Ayre; George Henry Vane Appleby, M.D.; Thomas George Wakeling; Douglas Reginald Pike, M.B.; Alexander Burns, M.B.; Herbert William Black Ruxton, M.B.; Edwin Augustus Hutton-Attenborough; David Macnish, M.B.; Frank Edgar Marshall, M.B.; James McAlpine Scott, M.D.; David Anderson, M.B.; Robert Godwin Chase, M.B.; Thomas Joseph Taunton; Charles William Ensor; Hugh Robinson Irvine; James Logan; Ernest Lawton Matthew.

The undermentioned temporary honorary Lieutenants to be temporary Lieutenants:—

Dated October 18, 1915.—Joseph Russell Tibbles.

Dated October 19, 1915.—Charles Sherbourne Dodson.

Dated October 23, 1915.—Septimus Alexander Forbes; Harry Arnold Ash.

Dated Octobor 24, 1915.—Eric Arnold Scott.

Dated October 26, 1915.—Andrew Royston Elliott, M.B.

Dated October 27, 1915.—Reginald Hugh Simpson, M.B.; Charles Cyril Okell.

The undermentioned to be temporary honorary Lieutenants:—

Dated October 10, 1915.—Rufus Clifford Thomas (substituted for the notification which appeared in the *Gazette* of November 5, 1915).

Dated November, 3, 1915.—Philip Hudson.

Dated November 9, 1915.—Tertius Thomas Boswall Watson; Ralph Godfrey Michelmore; Wilfrid Davison Newcomb.

Dated November 10, 1915.—Humphrey Nockolds, M.B., whilst serving with No. 3 British Red Cross Hospital.

Dated November 13, 1915.—Gordon Cranstoun; Harold Gardiner-Hill.

Dated November 15, 1915.—Geoffrey Oliver Hempson.

Dated November 16, 1915.—Edgar Broughton Barnes.

The notification regarding temporary Lieutenant David E. Fenwick, M.B., which appeared in the *Gazette* of October 23, 1915, is cancelled.

The undermentioned relinquish their commissions:—

Dated October 30, 1915.—Temporary Captain Arthur Matthey.

Dated November 4, 1915.—Temporary Lieutenant Warren Meade.

Dated November 10, 1915.—Temporary Lieutenant Harold C. Blexsome.

Dated November 18, 1915.—Temporary Honorary Captain J. L. Dickie, M.B.

The date on which temporary Lieutenant James L. Whatley relinquished his commission is October 23, 1915, and not as stated in the *Gazette* of November 11, 1915.

The undermentioned relinquish their commissions on account of ill-health:—

Dated November 5, 1915.—Temporary Lieutenant Harold Kempsey, M.B.

Dated November 14, 1915.—Temporary Lieutenant Joseph Brewer.

Dated November 15, 1915.—Temporary Captain Robert Lloyd Roe, M.B.

Dated November 25, 1915.—Temporary Lieutenant Henry James Thomson, M.B.

Dated December 1, 1915.—Temporary Lieutenant George Cooper, M.D.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated August 11, 1915.—Herbert John Middleweek.

Dated October 29, 1915.—James Alexander Jardine Currie.

Dated November 1, 1915.—Ernest Bantock Ringrose, Harold Lawson Jackson.

Dated November 2, 1915.—James Bruce Mackay, George Grossmith, Frederick Henry Gooderham.

Dated November 3, 1915.—Arthur Harwood Addey-Jibb.

Dated November 4, 1915.—John Tonkinson.

Dated November 8, 1915.—Hubert Frank Simnett.

Dated November 11, 1915.—Valentine Augustus Bell.

Dated November 14, 1915.—Peter Cunningham.

QUEEN ALEXANDRA'S IMPERIAL MILITARY NURSING SERVICE.

The undermentioned Staff Nurses to be Sisters:—

Dated November 27, 1915.—E. A. Harvey; M. E. Smith.

TERRITORIALS.

Royal Army Medical Corps.

3rd Scottish General Hospital.—Captain Alexander J. Archibald, M.B., is seconded for duty with an Ambulance, dated November 6, 1915.

Highland Mounted Brigade Field Ambulance.—Lieutenant David D. Mackay M.B., to be Captain, dated September 22, 1915.

1st Highland Field Ambulance.—Lieutenant Henry Begg, M.B., to be Captain, dated October 29, 1915.

2nd Highland Field Ambulance.—Lieutenant John Moir, M.B., to be Captain, dated October 29, 1915.

1st Lowland Field Ambulance.—Lieutenant Alexander G. Buchanan, M.B., to be Captain, dated November 5, 1915.

3rd Lowland Field Ambulance.—Lieutenant George J. Linklater, M.B., to be Captain, dated September 18, 1915.

2nd Northumbrian Field Ambulance.—Lieutenant Henry Stonehouse to be Captain, dated October 17, 1915; Lieutenant Wilson H. Morrison, M.B., from Attached to Units other than Medical Units, to be Lieutenant dated November 25, 1915.

2nd West Riding Field Ambulance.—Clement Hoyle Heppenstall, M.B., to be Lieutenant, dated November 2, 1915.

1st West Lancashire Field Ambulance.—Lieutenant Leonard B. Stott, M.B., to be Captain, dated September 16, 1915.

2nd East Lancashire Field Ambulance.—Lieutenant Graham Stevenson, M.B., to be Captain, dated October 1, 1915; Benjamin Robertshaw to be Lieutenant, dated October 12, 1915.

3rd West Lancashire Field Ambulance.—Major Thomas Holt, M.D., from Attached to Units other than Medical Units, to be Major, dated December 3, 1915.

East Lancashire Casualty Clearing Station.—Walter Briggs, M.B., to be Lieutenant, dated October 11, 1915; Jeffrey Ramsay, M.D., to be Lieutenant, dated October 12, 1915.

1st North Midland Field Ambulance.—Frederick Charles Pridham, F.R.C.S., to be Lieutenant, dated November, 15 1915.

3rd North Midland Field Ambulance.—Captain William McC. Wanklyn, from Deputy Assistant Director of Medical Services, North Midland Division, to be Captain, dated November 9, 1915.

North Midland Casualty Clearing Station.—James Anderson Young, M.B., to be Lieutenant, dated November 2, 1915.

1st South Midland Field Ambulance.—Surgeon Captain George Mackie, from 2nd South Midland Brigade, Royal Field Artillery, to be Captain, dated November 16, 1915; Captain George Mackie to be temporary Major, dated November 16, 1915; Captain Ernest E. B. Landon, from Attached to Units other than Medical Units, to be Captain, dated November 27, 1915.

2nd South Midland Field Ambulance.—Captain Reginald D. Moore, from Attached to Units other than Medical Units, to be Captain, dated November 18, 1915.

3rd South Midland Field Ambulance.—Cyril Claude Lavington, M.B. (late Captain in this Unit), to be Captain, dated November 18, 1915.

South Midland Casualty Clearing Station.—Lieutenant Astley B. Prosser, M.B., to be Captain, dated October 27, 1915.

1st Wessex Field Ambulance.—John Booth Kelly, to be Lieutenant, dated November 20, 1915.

Wessex Divisional Sanitary Section.—William Harry Biggs, to be Lieutenant, dated November 20, 1915.

Wessex Casualty Clearing Station.—Major Robert A. Draper, from Yorkshire Mounted Brigade, Field Ambulance, to be Major, dated November 17, 1915.

2nd Welsh Field Ambulance.—Lieutenant Thomas P. Edwards, M.D., to be Captain, dated July 11, 1915.

3rd Welsh Field Ambulance.—Lieutenant-Colonel Arthur L. Jones, from the Territorial Force Reserve, to be Lieutenant-Colonel, dated January 1, 1915; Lieutenant-Colonel Arthur L. Jones to be seconded for duty as Senior Medical Officer, Swansea Coast Defences, dated January 1, 1915; Lieutenant John W. Dale, M.B., to be Captain, dated September 3, 1915.

Welsh Border Mounted Brigade Field Ambulance.—Lieutenant Frank L. Newton, M.B., to be Captain, dated September 26, 1915.

Welsh Casualty Clearing Station.—Lieutenant John Anderson, M.B., to be Captain, dated October 29, 1915.

2nd Northern General Hospital.—Captain Joseph le F. C. Burrow, M.B., is seconded for duty with North Midland Mounted Brigade Field Ambulance, dated October 1, 1915; Captain John B. Hall is seconded for duty with East Anglian Casualty Clearing Station, dated September 30, 1915; Lieutenant-Colonel Joseph Faulkner Dobson, M.B., F.R.C.S., is placed on temporary Half-pay List on account of ill-health, dated December 3, 1915.

4th Northern General Hospital.—Captain William R. Higgins, M.B., is seconded for duty on a Hospital Ship, dated October 21, 1915. The undermentioned Lieutenants to be Captains: Henry J. Smith, M.B., dated November 17, 1915; Christopher W. Sharpley, dated December 2, 1915.

1st Western General Hospital.—Captain Robert E. Kelly, M.D., F.R.C.S., is seconded, dated October 29, 1915.

3rd Western General Hospital.—Evan Davies to be Quartermaster, with the honorary rank of Lieutenant, dated September 20, 1915.

1st Eastern General Hospital.—Victor Thomas Ellwood, M.B., to be Lieutenant, dated November 16, 1915.

2nd Eastern General Hospital.—Lieutenant-Colonel Edward F. Maynard, M.D., is seconded for duty at Ravenscroft Military Hospital, dated November 23, 1915.

Eastern Mounted Brigade Field Ambulance.—Transport Officer and Honorary Lieutenant John Ashurst resigns his commission, dated December 2, 1915.

South-Eastern Mounted Brigade Field Ambulance.—Captain Alexander G. S. Logie, M.B., is seconded for duty with Highland Mounted Brigade Field Ambulance, dated December 3, 1915.

1st Southern General Hospital.—Lieutenant Alfred P. Phillips to be Captain, dated May 24, 1915; Lieutenant Arthur C. Tibbits, to be Captain, dated October 6, 1915.

2nd Southern General Hospital.—Lieutenant-Colonel Edmund C. Board resigns his commission on account of ill-health, dated November 30, 1915.

3rd Southern General Hospital.—John Gardiner to be Captain, whose services will be available on mobilization, dated November 9, 1915; Edwin Morton, M.D. (late Surgeon-Lieutenant, 3rd Volunteer Battalion, The South Staffordshire Regiment), to be Captain, whose services will be available on mobilization, dated November 18, 1915.

4th Southern General Hospital.—Major John Mortimer, M.B., resigns his commision on account of ill-health, dated December 2, 1915.

1st East Anglian Field Ambulance.—Eric John Staddon, to be Lieutenant, dated November 20, 1915.

2nd East Anglian Field Ambulance.—Captain Archibald B. Pettigrew is seconded for duty with the East Anglian Divisional Ammunition Column, dated November 12, 1915; William John Dearden, to be Lieutenant, dated July 21, 1915.

East Anglian Casualty Clearing Station.—Lieutenant Robert C. S. Smith, M.B., to be Captain, dated October 9, 1915.

1st Home Counties Field Ambulance.—Lieutenant Francis S. Jackson, to be Captain, dated September 16, 1915; Major Arthur T. Falwasser, to be temporary Lieutenant-Colonel, dated November 27, 1915.

3rd Home Counties Field Ambulance.—Francis Poole, to be Quartermaster, with the honorary rank of Lieutenant, dated November 16, 1915. The date of promotion of Major Hector G. G. Mackenzie, M.D., to temporary Lieutenant-Colonel is May 21, 1915, and not as stated in the *London Gazette* of September 10, 1915.

Home Counties Casualty Clearing Station.—Thomas Watson Hancock, to be Lieutenant, dated November 9, 1915; Wilfred Lawrence Hibbert, to be Lieutenant, dated November 9, 1915; Arthur Griffith Williams, to be Lieutenant, dated November 9, 1915; Henry Ray Parsloe, to be Lieutenant, dated November 25, 1915; Captain William M. Parham, M.D., to be temporary Major, dated December 2, 1915; Captain Gerald W. C. Hollist, from Attached to Units other than Medical Units, to be Captain, dated December 3, 1915.

1st London (City of London) Sanitary Company.—The following announcement is substituted for that which appeared in the *London Gazette* of May 29, 1915: Lieutenant John H. Baldwin to be Captain, dated April 1, 1915, with seniority next below Captain Arthur T. Pitts; Lieutenant John Golding to be Captain, dated October 8, 1915; Walter Buddin to be Lieutenant, dated October 11, 1915; Edward William Gregory to be Lieutenant, dated October 11, 1915; Lieutenant Gilbert N. Anderson, M.B., to be Captain, dated October 15, 1915; Robert John Stewart McDowall, M.B., to be Lieutenant, dated November 1, 1915; James Philip Elias, M.B., to be Lieutenant, dated November 28, 1915.

2nd London (City of London) Field Ambulance.—Lieutenant William T. Homan to be Captain, dated October 7, 1915; Captain Louis Courtauld, M.B., is seconded for duty at Netley, dated November 11, 1915.

2nd London Casualty Clearing Station.—Captain Claude H. S. Frankau, M.B., F.R.C.S., to be temporary Major, dated October 20, 1915.

2nd London Sanitary Company.—Lieutenant Owen H. Peters, M.B., to be Captain, dated October 15, 1915; Lieutenant Edwin J. Messent to be Captain, dated November 17, 1915; Herbert John Leslie Barefoot to be Lieutenant, dated November 15, 1915; Bernard Robinson Hebblethwaite to be Lieutenant, dated November 16, 1915; Serjeant Harold Stanton Tebbitt from 1st London Sanitary Company, to be Lieutenant, dated November 19, 1915; Second Lieutenant Kenneth Bertram Williamson, from the Unattached List for the Territorial Force, to be Lieutenant, dated November 27, 1915.

3rd London General Hospital.—Lieutenant William F. B. Bensted-Smith to be Captain, dated October 10, 1915.

4th London Field Ambulance.—Quartermaster and Honorary Captain James P. Ekins is seconded, dated November 11, 1915; Quartermaster and Honorary Lieutenant Reginald R. Whitty, from 6th London Field Ambulance, to be Quartermaster with the honorary rank of Lieutenant, dated November 2, 1915.

5th London General Hospital.—The undermentioned to be Captains, whose services will be available on mobilization: Harold Low, M.B., dated August 16, 1915; Charles Richard Box, M.D., F.R.C.S., dated August 16, 1915; John Shields Fairbairn, M.B., F.R.C.S., dated August 16, 1915; James Montagu Wyatt, dated August 16, 1915; John Herbert Fisher, M.B., F.R.C.S., dated August 16, 1915: Alfred Ernest Russell, M.D., dated September 20, 1915. William Joseph Teil Kimber to be Lieutenant, dated August 16, 1915.

London Mounted Brigade Field Ambulance.—Frederick Porter Smith to be Lieutenant, dated November 20, 1915; Henry Fulton (Honorary Major, retired, Special Reserve, late Captain, London Signal Companies (Army Troops), Royal Engineers), to be Major, dated November 27, 1915. The undermentioned Lieutenants (on probation) are confirmed in their rank: William Hunt, M.B.; Cecil McL. West, M.B. Lieutenant (on probation) William W. Blair, M.B., is confirmed in his rank.

Sanitary Service.

Robert John Fleming, M.B., to be Captain, whose services will be available on mobilization, dated November 17. 1915.

Attached to Units other than Medical Units.

Lieutenant Thomas A. Fisher, to be Captain, dated April 1, 1915.
The undermentioned Lieutenants to be Captains:—
Robert McAdoo, M.B., dated April 1, 1915.
Thomas W. H. Downes, dated April 1, 1915.
Lieutenant George H. H. Waylen to be Captain, dated April 1, 1915.
John E. Pearce, dated April 8, 1915.
Lieutenants Henry W. Lance, M.B., to be Captain, dated April 17, 1915.
Lieutenant Robert U. Moffat, C.M.G., M.D., to be Captain, dated May 4, 1915.
Lieutenant Archibald Oliver M.D., to beCaptain dated May 4, 1915.
Lieutenant Philip H. G. Gosse to be Captain, May 16, 1915.
Henry W. Case, M.B., dated June 10, 1915.
Frederick W. A. Stott, M.B., dated July 16, 1915.
The date of promotion of Captain James N. Macmullan to Major is August 5, 1914, and not as stated in the *London Gazette* of June 26, 1915.
Thomas Porter, M.B., dated September 23, 1915.
Captain Charles C. Grummitt, from 3rd North Midland Field Ambulance, to be Captain, dated October 3, 1915.
Major Paul McK. Terry, from Wessex Casualty Clearing Station, to be Major, dated October 6, 1915.
Lieutenant William H. Calvert, M.D., to be Captain, dated October 19, 1915.
George Richard Wilson, M.B. (late Captain, 4th Battalion, The East Lancashire Regiment), to be Captain, dated October 19, 1915.

Lieutenant Thomas S. Allan to be Captain, dated October 21, 1915.

Lieutenant Richard P. Pollard, M.B., to be Captain, dated October 22, 1915.

Lieutenant Walter Mundy Cox to be Captain, dated October 29, 1915.

William Young Martin, M.B. (late Captain, 5th Battalion, The Manchester Regiment), to be Captain, dated November 4, 1915.

James J. Marsh, dated November 7, 1915.

Henry Guy Ludolf (late Lieutenant, West Riding Divisional Train, Army Service Corps) to be Lieutenant, dated November 20, 1915.

Arthur Butler-Harris, M.B. (late Major, 4th Battalion, The Essex Regiment), to be Major, dated November 23, 1915.

Captain John Cook, from 1st Welsh Field Ambulance, to be Captain, dated November 27, 1915.

William Allan Smith, M.B. (late Major, 4th Battalion, The East Lancashire Regiment), to be Major, dated November 4, 1915.

BIRTH.

FOSTER.—On November 19, 1915, at Woodgate House, Wimbledon, the wife of Captain A. L. Foster, R.A.M.C., of a daughter.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W.

Communications have been received from Surgeon-General Sir Anthony Bowlby, K.C.M.G., Lieutenant-Colonel Andrew Balfour, C.M.G., Lieutenant-Colonel A. D. Sharp, Major H. R. Dean, Major W. McAdam Eccles, Major A. F. Hertz, Captain T. S. Allen, Captain E. M. Cowell, Captain A. W. M. Ellis, Captain A. F. Engleton, Captain T. S. Hudson, Captain T. B. Mouat, Captain A. W. Nuthall, Captain A. W. Ormond, Captain J. R. R. Trist, Lieutenant E. P. Evans, Lieutenant A. C. Inman, Lieutenant J. R. Lee, Lieutenant D. C. Taylor, Lieutenant J. R. White, Serjeant-Major E. B. Dewberry, Professor Leonard E. Hill, F.R.S.

The following publications have been received :—

British : The Medical Press and Circular, The Society of Tropical Medicine and Hygiene, Guy's Hospital Gazette, The Medical Journal of Australia, The Indian Medical Gazette, The Sanitary Record and Municipal Engineering, The Journal of Tropical Medicine and Hygiene, The Hospital, The Lancet, The Practitioner, The Journal of State Medicine, The St. Thomas's Hospital Gazette, The Royal Engineers' Journal, Journal of the Royal United Service Institution, Red Cross and Ambulance News.

Foreign : Bulletin of the Johns Hopkins Hospital, Giornale de Medicina Militare, United States Public Health Service, Bulletin de l'Institut Pasteur, The Military Surgeon, International Military Digest, Bulletin of the United States Department of Agriculture, Bulletin de la Société de Pathologie Exotique, Revista de Sanidad Militar.

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